

***Review of
Removable
Partial Dentures***

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Review of Removable Partial Dentures

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Review of Removable Partial Dentures

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*Dedicated to
My Almighty GOD
and
My Family*

FOREWORD

The ever-increasing number of textbooks and other literature, which is available for reference to the Dental profession, each year makes it difficult for the average undergraduate dental student to prepare adequately for their examinations.

Often, the diverging views of the authors, on a particular subject, leave the candidates in confusion regarding the correct answer to be given. This is more evident when answering essay and short note type questions.

Dr. Lovely has taken great pains to tackle this problem by arriving at acceptable answers to the above-mentioned types of questions. The systematic and topic-wise layout of the answers makes it easy for the students to reproduce.

Even though many guidebooks are available in the market to help the students to answer the MCQ type questions, this is to my knowledge the first such book to guide the students in answering questions in the essay and short note format.

I am happy to introduce *Review of Removable Partial Dentures* to the present undergraduate students as well as the Dental Profession in general. I hope it will lend a helping hand to many aspirants of higher education in Dentistry.

Prof. George Paulose MDS (Prosthodontics)
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PREFACE

Review of Removable Partial Dentures is the second book in the examination review series in Prosthodontics being brought out as study aids for the undergraduate dental student appearing for the BDS university examinations.

It is meant as a continuation of the first book "*Review of Complete Dentures*" which was published earlier and is also similarly intended as a revision tool for students before the university examinations. However, I hope that this book will also be useful for practising dentists and postgraduate students to keep up with the latest in the subject.

This book helps the student to get an idea of how the questions are framed and how to answer in a structured manner. The questions in this book are from actual university examination question papers sourced from all over the country. The answers are formulated after much painstaking reference with all the standard textbooks in Removable Partial Dentures.

The inspiration for this book was the need that I myself felt, as a student, for such a revision tool, just prior to my examination, and therefore, I hope that the present students will take full benefit of it.

I thank God for enabling me to bring out this book in time. I especially thank Prof. K. Chandrasekharan Nair for his invaluable help and time in going through and correcting the proofs of this review. Thanks are due to Dr. Krishna Mohan Reddy, Dr. Binoy, Dr. Murukan, Dr. Jitendra Jethwani, Dr. Gayathri and all of my friends and colleagues all over India who sent me question papers from their Universities. Special thanks to my department colleague, Dr. James. R. Rex, for his help in drawing the diagrams, which are included in this review. I also thank my department colleagues Dr. Mohan Kumar,

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Dr. K.C. Nayar, Dr. Prashanth, Dr. Seema and Dr. Akhila for their encouragement and help. Last but not least, I thank my husband, parents and in-laws for their encouragement and support.

Lovely M

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Essays



EXPLAIN THE IMPORTANCE OF DIAGNOSTIC AND TREATMENT PLANNING PHASES IN RPD

Diagnosis and Treatment Planning

Diagnosis is the examination of the physical state, evaluation of the mental or psychological makeup and understanding the needs of each patient to ensure a predictable result.

Treatment planning means developing a course of action that encompasses the ramifications and sequelae of treatment to serve the patient's needs.

Oral Examination Includes Evaluating

1. Carious lesions and defective restorations.
2. Testing for pulp vitality.
3. Test for sensitivity to percussion.
4. Mobility.
5. Pocket depth, inflammation and amount of attached gingiva of the abutment teeth.
6. Any tori, exostoses, sharp or prominent bony areas, soft or hard tissue undercuts and enlarged tuberosities.

Other Diagnostic Aids Required

- Radiographs of the abutment teeth and the residual ridge areas.
- Mounted casts: To evaluate for the presence of extruded teeth, malposed teeth, reduced interarch space and unfavourable occlusal plane.

Evaluation of Caries and Existing Restorations

1. All caries lesions need to be restored with intracoronal restoration.
2. Extruded tooth above the occlusal plane need to be restored with an extra coronal restoration to improve the occlusal plane.
3. If rest seat need to be prepared a cast metallic restoration is preferred as restoration.

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Evaluation of Pulp

- An electric pulp tester and thermal tests are used to detect pulpal necrosis or pulpitis.
- Endodontically treated tooth, if used as an abutment, should be evaluated for the success of endodontic treatment.

Evaluation of Sensitivity to Percussion

Sensitivity can be due to

1. Tooth movement caused by a prosthesis or the occlusion.
2. A tooth or restoration in traumatic occlusion.
3. Periapical or pulpal abscess.
4. Acute pulpitis.
5. Gingivitis or periodontitis.
6. Cracked tooth syndrome.

Evaluation of Mobile Teeth

A mobile tooth used as an abutment tooth will have a poor prognosis unless mobility is eliminated.

Causes of mobility

1. Trauma from occlusion (reversible).
2. Inflammatory changes in the periodontal ligament (reversible).
3. Loss of alveolar bone support (not reversible).

Abutment teeth can be splinted to decrease mobility only if

- The combined splinted teeth with crowns provide an abutment with greater total periodontal support.
- Splinting can be done if two or three retainable teeth are widely placed.

Evaluation of Periodontium

Findings requiring periodontal treatment are

1. Pocket depth in excess of 1 mm with furcation involvement.

2. Gingivitis.
3. Marginal exudate.
4. Less than 2 mm of attached gingiva.
5. High frenal attachment.

Periodontal treatments include

- Root scaling, root planning with good home oral hygiene procedures.
- Gingivectomy, periodontal flap procedures and free gingival grafts.

Evaluation of Oral Mucosa

Ulceration, swelling, or colour change as red or white lesions.

Common tissue reactions in prosthesis wearing patients

1. Palatal papillary hyperplasia.
2. Inflammatory papillary hyperplasia.
3. Epulis fissuratum.
4. Denture stomatitis.
5. Trauma from occlusion.
6. Soft tissue displacement.

Evaluation of Soft Tissue Abnormalities

1. High frenal attachment of labial frenum
2. Hypertrophic lingual frenum
3. Vestibular extension or ridge augmentation procedures can be done.
4. Xerostomia.

Evaluation of Hard Tissue Abnormalities

Torus Palatinus: A major connector can be selected and designed to circumvent the torus.

Torus Mandibularis: Occurring bilaterally on the lingual surface of the mandible, which needs to be surgically removed before construction of a removable partial denture.

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Exostoses and Undercuts: Surgical correction by simple alveolectomy.

The maxillary tuberosities: Need to be surgically corrected if support and stability of the prosthesis is affected.

Mandibular tuberosity: The mandibular lingual tuberosity is a bony protuberance at the distal end of the mylohyoid ridge in the third molar area. This should be surgically reduced.

Evaluation of Space for Mandibular Major Connector

A minimum of 7 to 8 mm of space should be available for a lingual bar major connector and if less than 7 mm of space is available a lingual plate major connector should be used.

A periodontal probe with millimetre markings is used to measure the space in the lingual aspect. The millimetre depth is read at the point where the probe contacts the gingival margin.

Evaluation of Radiographic Survey

- Abutment tooth is evaluated.
- Residual ridge is evaluated.
- Other factors as radiolucencies, radio opacities, root tips, impacted tooth, endodontically treated tooth are evaluated.

Radiographic Evaluation of Abutment Teeth

1. Root length, size and form.
2. *Crown/Root ratio:* at least 1:1 is required for an abutment tooth.
3. *Lamina Dura:* Should be checked for absence, discontinuity, partial loss or thickening of lamina dura.
4. *Periodontal Ligament Space:* A widening of the periodontal ligament space with a thickening of the lamina dura indicates occlusal trauma and heavy function.
Clinical mobility of the tooth may also be present with the above findings.

5. *Bone Index Areas:* Bone index areas have “a positive bone factor” which includes a supportive trabecular pattern, heavy cortical layer, dense lamina dura, normal bone height and a normal periodontal ligament space.

Evaluation of Mounted Diagnostic Casts

1. Insufficient interarch distance,
2. Irregular occlusal plane,
3. Extruded or malposed teeth and
4. Unfavourable maxillomandibular relationships are all better visualised on mounted diagnostic cast.

1. Interarch Distance

A decrease in interarch distance occurs when tooth unopposed by occlusion tend to over erupt over a period of time carrying the alveolar process with it. Surgical correction can be done.

2. Occlusal Plane

Occlusal plane irregularity if mild can be corrected by enameloplasty.

In extrusion greater than 2 mm the placement of an extra-coronal cast metallic restoration is indicated.

3. Traumatic Vertical Overlap

Akerly classification:

Type I —The mandibular incisors extrude and impinge into the palate.

Type II—The mandibular incisors impinge into the gingival sulci of the mandibular incisors.

Type III—Both maxillary and mandibular incisors incline lingually with impingement of the gingival tissues of each arch.

Type IV—The mandibular incisors move or extrude into the abraded lingual surfaces of the maxillary anterior teeth.

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Clinical symptoms: Abrasion, mobility, migration of the teeth, inflammation and ulceration of the gingiva and palatal mucosa.

Can be corrected by: Orthodontic and orthognathic combined surgical procedures.

Lingual plates that extend on to the lingual surfaces of the maxillary anterior teeth.

4. *Malrelation of jaws*

Maxillary and mandibular osteotomy procedures are useful to correct these problems.

5. *Tipped or malposed teeth*

Limited orthodontic procedures for minor tooth movement can be used to upright the tipped tooth to allow the placement of an artificial tooth.

6. *Occlusion*

A discrepancy between centric jaw relation and maximum occlusal contact, or centric occlusion should be evaluated and corrected by selective grinding or coronal reshaping of teeth to, produce simultaneous occlusal contacts.

Prosthesis need to be constructed at centric jaw relation when:

1. Absence of posterior tooth contacts.
2. Situation in which all posterior tooth contacts are to be restored with cast restorations.
3. Only a few remaining posterior contacts.
4. Minimum alveolar support for all the remaining teeth corrected by minimum occlusal equilibration.
5. Anterior slide from centric jaw relation and symptoms of traumatic occlusion of the anterior teeth.

Treatment planning

The treatment of the partially edentulous patient can be divided into five phases.

Phase I

1. Collection and evaluation of the diagnostic data.
2. Treatment to control pain or infection.
3. Biopsy or referral of patient.
4. Development of a treatment plan.
5. Education and motivation of patient.

Phase II

1. Removal of deep caries and placement of temporary restorations.
2. Extirpation of inflamed or necrotic pulp tissues.
3. Removal of non-retainable teeth.
4. Periodontal treatment.
5. Construction of interim prosthesis for function or aesthetics.
6. Occlusal equilibration.
7. Reinforcement of education and motivation of patient.

Phase III

1. Preprosthetic surgical procedures.
2. Definitive endodontic procedures.
3. Definitive restoration of teeth, such as cast metallic restorations.
4. Fixed partial denture construction.
5. Reinforcement of education and motivation of patient.

Phase IV

1. Construction of removable partial denture.
2. Reinforcement of education and motivation of patient.

Phase V

1. Post insertion care.
2. Periodic recall.
3. Reinforcement of education and motivation of patient.

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Length of appointment: The length of this appointment can vary greatly, depending on the complexity of the problems presented by the patient.

LIST VARIOUS CLASSIFICATIONS OF RPD AND THE BASIS FOR CLASSIFYING PARTIALLY EDENTULOUS SITUATION. ENUMERATE MERITS OF KENNEDY'S CLASSIFICATION

Various Classifications

Cummer 1921, Kennedy 1923, Bailyn 1928, Neurohr 1939, Mauk 1942, Wild 1949, Godfrey 1951, Friedman 1953, Beckett 1953, Craddock 1954, Swenson and Terkla 1955, Skinner 1957, Austin 1957, Walt et al 1958, Applegate-Kennedy 1960, Terkla and Laney 1963, William Avent 1966, Fiset 1973, Costa 1974 and Osborne and Lammie 1974

Requirements of an acceptable method of classification

1. It should permit immediate visualization of the type of partially edentulous arch being considered.
2. It should permit immediate differentiation between the tooth-borne and tooth- tissue supported removable partial denture.
3. It should be universally acceptable.

Support classification

- Tooth-borne.
- Mucosa-borne.
- Tooth and mucosa-borne.

Kennedy's classification

A world wide accepted classification is that devised by Edward Kennedy in 1923.

When used in conjunction with a support classification, it helps to give a clear classification understanding about the type

of denture under consideration during a discussion on partial dentures.

The Kennedy classification is based on the relationship of the saddles to the natural teeth.

Kennedy's classification has four main groups with modifications except for Class IV

- Class I:** Bilateral free-end edentulous spaces posterior to the natural teeth.
- Class II:** Unilateral free-end edentulous space posterior to the natural teeth.
- Class III:** A bounded unilateral edentulous space having natural teeth at each end.
- Class IV:** A bounded edentulous space anterior to the natural teeth.

Modifications

All classes, except Class IV, have modifications.

Each modification is an additional edentulous area.

Examples of modifications:

- An additional edentulous area in Class I would be designated as Class I modification 1.
- If two additional edentulous areas are present it could be designated as Class I modification 2.
- A unilateral saddle with one additional edentulous area is Class II modification 1.
- A unilateral bounded edentulous area with three additional edentulous areas is Class III, modification 3.

Class IV has no modifications.

Criteria for the Kennedy's classification

1. The most posterior edentulous area determines the class.
2. The size of the modification is not important.
3. If a third molar is missing, and not to be replaced, it is not considered in determining the class.

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Merits of Kennedy's classification

1. Allows visualization of partially edentulous arch.
2. Differentiates between tooth supported and tooth tissue supported.
3. Type of design can be decided.
4. Is universally accepted.
5. Aids in discussing, identifying and planning the design.
6. Easy to apply the system to any situation.
7. Widely used system.
8. Forms the basis for two other systems as Applegate Kennedy and Swenson's system.

Diagrams



Figure 1: Kennedy's class I



Figure 2: Kennedy's class II



Figure 3: Kennedy's class III



Figure 4: Kennedy's class IV

DISCUSS VARIOUS CLASSIFICATIONS OF PARTIALLY EDENTULOUS RIDGE. EXPLAIN KENNEDY APPLIGATE'S MODIFICATION

Several methods of classification of partially edentulous arches have been proposed and are in use today. There are over 65,000

possible combinations of teeth and edentulous spaces in opposing arches.

No single method of classification can describe all the combinations except the most basic types.

Kennedy's method of classification is the most widely accepted classification of partially edentulous arches today.

A few other classifications

Cummers classification (1921)

First classification to be recognised by the dental profession.

He classified partial dentures than edentulous spaces.

Four types:

1. Diagonal: 2 retainers diagonally opposite one another.
2. Diametric: 2 retainers diametrically opposite one another.
3. Unilateral: 2 or more direct retainers on same side.
4. Multilateral: 3 direct retainers on either side.

Charles. W. Bailyn (1928)

He emphasized the importance of support for partial dentures.

“A”—Anterior restorations where there were saddle areas anterior to the bicuspid.

“P”—Posterior restorations where there were saddle areas posterior to the canines.

Classification

Class I: Bounded saddle (Tooth supported).

Class II: Free end saddle (Mucosa supported).

Class III: Bounded saddle (More than three tooth missing).

Example: If all posterior teeth from canines till molars are missing with lateral incisors then the classification is AI P III.

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Neurohrs Classification

Class I:

Variation I:

- a. Posterior missing, Anterior all teeth present.
- b. Posterior missing, some anterior teeth missing.

Variation II:

- a. Anterior missing, All posteriors present.
- b. Anterior missing, some posteriors missing.

Class II: Division I has variation 1 and 2.

Division II has variation 1 and 2.

This classification is tooth tissue bearing.

Class III is edentulous state.

Friedmans system

A—Anterior space.

B—Bounded posterior space.

C—Cantilever situation or a posterior free end saddle.

Osborne and Lammie

Class I: Mucosa borne.

Class II: Tooth borne.

Class III: Combination of mucosa borne and tissue borne.

Requirements of an acceptable method of classification

1. It should permit immediate visualization of the type of partially edentulous arch being considered.
2. It should permit immediate differentiation between the tooth-borne and the tooth-and tissue-supported removable partial denture.
3. It should be universally acceptable.

Kennedy's classification

The Kennedy method of classification was originally proposed by Dr. Edward Kennedy in 1923 and attempts to classify the

partially edentulous arch suggesting principles of design for a given situation.

Kennedy divided partially edentulous arches into four main types.

Class I

Bilateral edentulous areas located posterior to the remaining natural teeth.

Class II

A unilateral edentulous area located posterior to the remaining natural teeth.

Class III

A unilateral edentulous area with natural teeth remaining both anterior and posterior to it.

Class IV

A single, but bilateral (crossing the midline), edentulous area located anterior to the remaining natural teeth.

Modifications

All classes, except Class IV, have modifications.
Each modification is an additional edentulous area.

Examples of Modifications

- An additional edentulous area in Class I would be designated as Class I modification 1.
- If two additional edentulous areas are present it could be designated as Class I modification 2.
- Class II modification 1: a unilateral edentulous area with one additional saddle.
- Class III, modification 3 would be a unilateral bounded edentulous area with three additional edentulous areas.
- Class IV has no modifications.

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Criteria for the Kennedy's classification

1. The most posterior edentulous area determines the class.
2. The size of the modification is not important.
3. If a third molar is missing, and not to be replaced, it is not considered in determining the class.

Merits of Kennedy's classification

- a. Allows visualization of partially edentulous arch.
- b. Differentiates between tooth supported and tooth tissue supported.
- c. Type of design can be decided.
- d. Is universally accepted.
- e. Aids in discussing, identifying and planning the design.
- f. Easy to apply the system to any situation.
- g. Widely used system.
- h. Forms the basis for two other systems as Applegate Kennedy and Swenson's system.

Applegate's rules for applying the Kennedy classification

Applegate provided the following eight rules for the easy application of the Kennedy method:

- Rule 1.** Classification should follow rather than precede any extractions of teeth that might alter the original classification.
- Rule 2.** If a third molar is missing and not to be replaced, it is not considered in the classification.
- Rule 3.** If a third molar is present and is to be used as an abutment, it is considered in the classification.
- Rule 4.** If a second molar is missing and is not to be replaced, it is not considered in the classification.
- Rule 5.** The classification is always determined by the most posterior edentulous area or areas.

- Rule 6.** Edentulous areas other than those determining the classification are referred to as modifications and are designated by their number.
- Rule 7.** The extent of the modification is not considered, only the number of additional edentulous areas.
- Rule 8.** There can be no modification areas in Class IV arches. (Another edentulous area lying posterior to the “single bilateral area crossing the midline” would determine the classification.)

Applegate added two more classes to Kennedy’s existing classification

Class V

This is an edentulous area, bounded anteriorly and posteriorly by natural teeth, in which the anterior abutment is not suitable for support.

Class VI

This is an edentulous situation in which the abutment tooth is capable of total support. (As in young patients.)

DEFINE MAJOR CONNECTOR. EXPLAIN IN DETAIL ITS REQUIREMENTS. DESCRIBE MAXILLARY MAJOR CONNECTORS IN DETAIL

Definition

A major connector is the unit of the partial denture that connects the parts of the prosthesis located on one side of the arch with those on the opposite side. It is that unit of the partial denture to which all other parts are directly or indirectly attached.

Requirements of major connector

1. Major connectors must be rigid to transfer forces uniformly over the entire supporting structures.

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2. Prevents movement of the denture base by its rigidity.
3. Aids the other components of the partial denture to function effectively.
4. They should not be placed on excessively movable tissues.
5. Should be placed 4 mm away from gingival margin in mandibular and 6 mm away from gingival margin in maxillary.
6. Should not be placed on bony and soft tissue prominences.
7. Relief should be provided beneath a major connector if necessary.
8. The borders of the palatal connector should be 6 mm away from gingival margins and should be parallel to their mean curve.
9. The anterior and posterior borders should cross midline at right angles.
10. Minor connectors must cross gingival tissues, at nearly a right angle while joining the major connector.
11. An anterior palatal strap or the anterior border of a palatal plate should be located as far posteriorly to avoid interference with the tongue.
12. The anterior border of such palatal major connectors should follow the valleys between the rugae.
13. Should maintain oral health.
14. All borders should taper towards soft tissue.
15. Should be made from an alloy compatible with oral tissues
16. Thickness of metal should be uniform through out.
17. Finished borders should curve gently.
18. Metal should not be highly polished on the tissue surface.
19. All borders on soft tissue should be beaded fading out near gingival margins.
20. Should not interfere and irritate the tongue.
21. Should not alter the natural contour of the lingual surface of the mandibular alveolar ridge or palatal vault.
22. Should not impinge on oral tissues during function.
23. Should not retain or trap food particles.
24. Aids in support, retention and stability.

Types of maxillary major connectors

1. Single posterior palatal bar.
2. Single palatal strap.
3. Anterior posterior palatal bar (Double palatal bar).
4. U-shaped palatal connector (Horse-shoe).
5. Combination anterior and posterior palatal strap-type connector (Closed horse shoe shaped).
6. Palatal plate-type connector (Complete palate).

Single palatal bar

- Is a narrow half oval shaped bar with the maximum thickness at the centre.
- Gently curves along the palatal contour with the junctions smoothly joining with the denture base.

Disadvantages

1. To maintain rigidity it should possess bulk causing tongue interference.
2. Decreased vertical support to prosthesis.
3. Cannot replace more than two teeth on each side of the arch.
4. Cannot be used in distal extension bases.

Advantages

Design for interim partial denture.



Figure 5: Single palatal bar

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Single palatal strap

- It is a wide, thin band of metal that crosses the palate. The minimum thickness of Palatal strap is 8 mm.
- Depending on the edentulous space the palatal strap can be made wider.
- Can be used for unilaterally edentulous situation.

Advantages

1. Greater resistance to displacing forces than a palatal bar.
2. Better patient comfort.

Disadvantages

1. Less rigidity compared to complete coverage major connector.
2. Papillary hyperplasia can occur.



Figure 6: Single palatal strap

Anterior Posterior Palatal Bar (Double Palatal Bar)

- It consists of a flat narrow anterior bar positioned in the valleys of rugae.
- It also consists of a half oval posterior bar. The anterior and posterior bars are joined by flat longitudinal elements in the lateral slopes of palate.

Advantages

1. It is rigid.
2. Can replace anterior and posterior abutments.

3. Less palatal coverage which is comfortable to the patient.
4. It is an ideal design for patients with large palatal tori.

Disadvantages

1. Less support.
2. Can be used only when there is good periodontal support.
3. Cannot be used in high palatal vaults.
4. Tongue interferences are present.



Figure 7: Double palatal bar (Anterior posterior palatal bar)

U-shaped Palatal Connector (Horseshoe)

- It is a thin band of metal along the lingual surfaces of tooth extending to the palatal slopes. Thickness of the plate should be minimum 6 to 8 mm.
- The borders can either extend from gingival margin to palatal slopes or from lingual aspect of the tooth to palatal slopes. The palatal borders should end at the junction of horizontal and vertical slopes of the palate.

Advantages

1. Ideal for replacement of missing anterior tooth.
2. This design provides some vertical support and indirect retention.
3. Can be designed in case of palatal tori.

Disadvantages

1. Cannot be given in distal extension partial denture as it flexes on loading.
2. Difficulty in speech and patient discomfort can occur.



Figure 8: U-shaped palatal connector

Anterior and posterior palatal strap-type connector (Closed horse shoe shaped)

- It consists of an anterior strap, which can be placed on the lingual aspect of tooth, or it should be placed 6 mm away from gingival margin, if anterior tooth are not replaced.
- It also consists of a posterior strap, which should be placed posteriorly but without contacting the soft palate.

Advantages

1. It is rigid and can replace anterior and posterior tooth.
2. Can be given in cases of palatal tori.

Disadvantage

Speech problems and tongue interference can occur.



Figure 9: Anterior-posterior palatal-strap

Palatal Plate-type Connector (Complete coverage)

- The anterior border should either extend to the cingula of the tooth surface or be kept 6 mm short of gingival margin.
- The posterior border should extend to the junction of soft and hard palate.

Types

- a. All acrylic resin.
- b. Combination of metal and acrylic (The anterior rugae area in metal and posteriorly acrylic).
- c. All cast metal.

Advantages

1. Good rigidity and support.
2. Better retention.
3. Maximum tissue coverage.
4. Can be given for bilateral distal extension.
5. Better stability in flat or flabby ridges.
6. Can be designed in obturator patients.
7. Design for transitional dentures (All acrylic).
8. Natural sensation during eating and drinking as in "All metal".
9. Can be relined later.

Disadvantages

1. Large area of tissue coverage can cause tissue reactions as hyperplasia.
2. Speech difficulties can occur.

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DESCRIBE MANDIBULAR MAJOR CONNECTORS. ADD A NOTE ON THE ADVANTAGES AND DISADVANTAGES OF EACH MANDIBULAR MAJOR CONNECTOR.

Definition

A major connector is the unit of the partial denture that connects the parts of the prosthesis located on one side of the arch with those on the opposite side. It is that unit of the partial denture to which all other parts are directly or indirectly attached.

Types of Mandibular Major Connectors

1. Lingual bar.
2. Lingual bar with continuous bar retainer (Kennedy Bar).
3. Linguoplate.
4. Labial bar.

Lingual Bar

Shape and size: A 6-gauge half-pear-shaped bar (5 mm) in width located above moving tissues but as far below the gingival tissues as possible.

Borders: Has two borders: Superior and inferior.

- The superior border should be tapered to the tissues above, with its greatest bulk at the lower border. It is flat on the tissue side and having the greatest bulk in the inferior third.
- Inferior border of the lingual bar is slightly rounded so that it will not impinge on the lingual tissue when the denture bases rotate inferiorly under occlusal loads. The major connector should not have sharp margins.

Location: The inferior border should be located so that it does not impinge on the tissues in the floor of the mouth during swallowing, speaking, and other normal functions.

The location should not interfere with the resting tongue and cause trapping of food.

The superior border should be located 3 mm away from gingival margins of teeth.

Minimum space required: At least 8 mm of vertical space between the floor of mouth and gingival margin is required.

Measuring the height of floor:

- The first method is to measure the height of the floor with a periodontal probe in relation to the lingual gingival margins of adjacent teeth with the tip of the patient's tongue lightly touching the vermilion border of the upper lip. (More accurate).
- The second method is to use an individualized impression tray with its lingual borders 3 mm short of the elevated floor of the mouth and then use an impression material that will be accurately moulded as the patient licks the lips.

The inferior border of the lingual bar can be located at the height of the lingual sulcus of the cast resulting from such an impression.

Advantages

1. Simplicity.
2. Minimal tissue contact.
3. Less plaque accumulation.

Disadvantages

1. Needs precise lab work.
2. Cannot be placed when there is less than 8 mm of lingual space.

Modifications

1. The thickness can be altered depending on the clinical situation to acquire more rigidity. This is accomplished by underlying the ready-made form with a sheet of 24-gauge casting wax.
2. Sublingual bar:
The bar shape is same as that of a lingual bar.

Location: Lying over and parallel to the anterior floor of the mouth.

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- Sublingual bar can be used along with a lingual plate if the lingual frenum does not interfere.
- Can be used when an anterior lingual undercut exist where lingual bar cannot be used.

Contraindications

1. When lingual tori exists.
2. In cases of high lingual frenal attachment.
3. High elevation of the floor of the mouth during functional movements.



Figure 10: Lingual bar

Continuous bar retainer (Kennedy's bar) or Double lingual bar

- A continuous bar retainer is located on or slightly above the cingula of the anterior teeth along with a lingual bar. The upper bar is also pear shaped and is 2 to 3 mm high with 1 mm thickness. The bar should dip into the contact points of teeth downward till upper limits of cingula.
- The two bars are joined by minor connector located in interproximal spaces usually between canine and premolar.

Indications

1. When a linguoplate cannot be given or if requires excessive blockout of interproximal undercuts then a continuous bar can be used.
2. In cases of wide diastemae between the lower anterior teeth.

Advantages

1. Enhance indirect retention.
2. Provides horizontal stabilization to the prosthesis.
3. Marginal gingiva receives natural stimulation.
4. Can be used in large interproximal embrasures.

Disadvantages

1. Tongue annoyance.
2. Entrapment of food.
3. Proper fit is difficult to achieve with upper bar of double bar.

Modifications (Step back design): The upper bar can be step backed in between each tooth as in cases of diastema, hence aesthetically pleasing.



Figure 11: Double lingual bar (NL) or below diagram

Linguoplate

Shape

- It is a pear shaped lingual bar with a thin solid piece of metal extending upward from superior border of bar to the lingual surfaces of teeth.
- A Linguoplate should be contoured to follow the contours of the teeth and the embrasures.
- The upper border should follow the natural curvature of the supracingular surfaces of the teeth also covering interproximal spaces to the contact points (Scalloped appearance).

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- All gingival crevices and deep embrasures must be blocked out parallel to the path of placement to avoid gingival irritation and wedging effect between the teeth.
- The Linguoplate should have a terminal rest at each end (commonly cingulum rest on canines or mesial fossae rest on first premolars).
- Material of choice-Chrome cobalt alloy.

Modification: Cut back or step back design to hide metal between wide spaced teeth without compromising the rigidity of the connector. Here the upper bar drops gingivally along the marginal ridge of tooth to cross gingiva to the other tooth and rises up the marginal ridge to the contact point.

Indications

1. When the lingual frenum is high or the space available for a lingual bar is limited.
2. In Class I situations in which the residual ridges have undergone excessive vertical resorption. Here Linguoplate will use remaining teeth to resist horizontal rotations.
3. For stabilizing periodontally weakened teeth. (A continuous bar retainer).
4. When the future replacement of one or more incisor teeth will be facilitated by the addition of retention loops to an existing Linguoplate.
5. In wide diastemae.

Advantages

1. Can be used in Class 1 situation when indirect retention is required.
2. In periodontally weak tooth lingual plate acts as splint.
3. Can be used with some modification to prevent supra eruption of mandibular anterior teeth.
4. Of all the mandibular major connectors lingual plate has maximum retention, support and stability.

Disadvantages

1. Irritation of soft tissues.
2. Caries prone.



Figure 12: Linguoplate

Labial Bar

Shape

- It is half pear shaped similar to lingual bar extending on to the labial surface and some time to the facial surface of the posterior tooth.
- Relief is required below the bar.

Indications

1. Extreme lingual inclination of the remaining lower premolar and incisor teeth. This should be rectified by mouth preparation and restoration before planning for a labial bar.
2. Large mandibular tori.

Modification: Swing-Lock design, which consists of a labial or buccal bar that is connected to the major connector by a hinge on one end and a latch at the other end.

Support is by multiple rests on the remaining natural teeth. Stabilization and reciprocation by linguoplate contacting the remaining teeth and by the labial bar with its retentive struts.

Retention is by bar-type retentive clasp arms projecting from the labial or buccal bar.

Use of the Swing-Lock

1. Unfavourable tooth contours.

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2. Unfavourable soft tissue contours.
3. Teeth with questionable prognoses.

Contraindications

1. Poor oral hygiene.
2. Presence of a shallow buccal or labial vestibule.
3. High frenal attachment.

Disadvantages

1. Bulk of connector distorts lower lip.
2. Patient discomfort.



Figure 13: Labial bar

Design of mandibular major connector

1. Outline of the basal seat areas on the diagnostic cast.
2. Outline of the inferior border of the major connector.
3. Outline of the superior border of the major connector.
4. Unification by minor connector.

**EXPLAIN IN DETAIL VARIOUS TYPES OF MINOR CONNECTORS.
ADD A NOTE ON THE FUNCTIONS OF MINOR CONNECTOR.**

Minor Connectors

Definition: Minor Connector is that component that joins other units of the prosthesis such as clasps, rests, indirect retainers and denture bases to the major connector.

Types of minor connector

1. Joins the clasp assembly to the major connector.
2. Joins indirect retainers or auxiliary rests to major connector.
3. Joins the denture base to the major connector.

4. Serves as an approach arm for a vertical projection or bar-type clasp.

I. Minor connectors that join clasp assembly to the major connector

- They should be rigid, as they support the retentive clasp and occlusal rest.
- To have rigidity they need to have sufficient bulk.

Location: Minor connectors that support clasp assemblies are located on proximal surfaces of teeth adjacent to edentulous areas or in the embrasure between two teeth.

Shape: Broad buccolingually and thin mesiodistally. The thickest portion buccolingually, should be at the lingual line angle of the tooth and taper evenly to its thinnest point at the buccal line angle of the tooth.

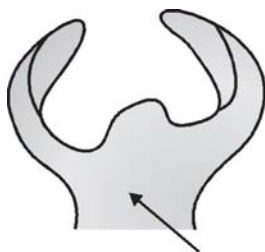


Figure 14: Minor connector joining clasp assembly

II. Minor connectors that join indirect retainers or auxiliary rests to major connector

- They arise from auxiliary rests. They should join the major connector at right angle.
- The joining junction should be a gentle curve.

Location: In the embrasure between teeth to prevent tongue annoyance.

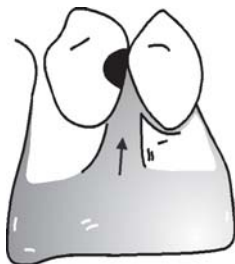


Figure 15: Minor connector joining indirect retainer

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III. Minor connectors that join denture base to major connector

Types of denture base

1. Latticework construction
2. Mesh construction
3. Bead, wire, or nail-head minor connectors.

1. Open latticework construction:

Consists of two longitudinal struts with smaller struts connecting the two longitudinal struts.

Maxillary design: This consists of two metal struts, 12 and 16 gauge thick.

The first extends longitudinally along the edentulous buccal ridge in maxillary arch.

The border of the major connector acts as the second strut.

Mandibular design: In the mandibular arch one strut should be positioned buccal to the crest of the ridge and the other lingual to the crest of the ridge.

Smaller struts: 16 gauge thick smaller struts, connect the two struts and form the latticework.

They run over the crest of the ridge and are positioned so that there is no interference to arrangement of the artificial teeth.

Number of small struts: Commonly one cross strut between each teeth to be replaced.

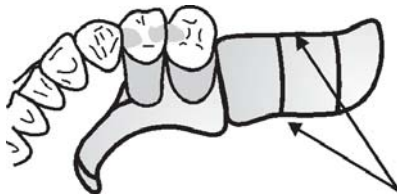


Figure 16: Minor connector joining denture base

Advantages

1. Strongest attachment of the acrylic resin denture base to the removable partial denture.

2. Easy to reline.
3. For multiple teeth replacement.

Mesh Construction

It is a thin sheet of metal with multiple small holes that extends over the crest of the residual ridge to the same buccal, lingual and posterior limits, as does the latticework minor connector.

Indication: When multiple teeth are to be replaced.

Disadvantages

1. Difficult for the acrylic resin to flow through the small holes.
2. Mesh type is a weak attachment.

Relief

- After the wax forms of the struts are positioned on the refractory cast, a relief space is provided over the edentulous ridges for both the latticework and the mesh minor connectors.
- This relief is provided to create a space between the struts and the underlying ridge around which the acrylic resin denture base will be retained.

Tissue stop: In distal extension partial dentures using latticework or mesh retention, the framework needs to be stabilized during the acrylic resin packing and processing.

As the acrylic resin requires some pressure to be forced through the latticework and mesh minor connectors, the framework can displace or distort, hence a tissue stop is required to support the terminal portion of the minor connector.

Method

1. Tissue stop is made by removing 2 square mm of the relief wax beneath the latticework.
2. The wax is removed from the point where the posterior end of the minor connector crosses the centre of the ridge.

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3. During waxing of the framework, this depression is waxed as a projection of the latticework or mesh.
4. After the framework has been cast this projection will contact the edentulous ridge of the cast and will prevent the framework from being distorted during acrylic resin packing procedures.

Bead, wire, or nailhead retention:

- The bead, wire, or nailhead minor connector is used with metal denture bases.
- No relief is provided beneath the minor connector as the acrylic resin mechanically bonds with the nail head or bead of the minor connector.

Mechanical retention:

- Can be made by placing beads of acrylic resin polymer on the waxed denture base and investing, and casting these beads.
- Wires or form of nailheads that project from the metal base can be used.

Disadvantages

1. It is difficult to adjust the metal base.
2. Cannot be relined in case of ridge resorption.
3. Weakest of the three types of attachment.
4. Can be only on tooth-supported, well-healed ridges.
5. Cannot use when interarch space is limited.
6. No strength to withstand the forces of occlusion.

Advantages

1. Hygienic because of better soft tissue response to metal.
2. Function successfully as better fit than acrylic denture base.

Attachment of minor connector to major connector

- Should be joined to major connector with adequate bulk to withstand occlusal forces and to prevent from breakage.

- The acrylic resin processed around the latticework and mesh minor connector should join the major connector in a smooth, even joint.
- To prevent acrylic resin from being thinned in order to produce a smooth joint, a space for a butt joint is placed in the design.
- The butt joint aids the acrylic resin to blend evenly with the major connector.

Finish lines/Butt joints

As acrylic resin is processed around the latticework and minor connectors, space for these butt joints are made on both internal and external surfaces of the major connector.

In the case of nail head minor connector, the acrylic resin is processed only on the external surface, so only a single finish line is required.

Types

- External Finish lines
- Internal Finish lines.

External finish lines

- If they occur on the outer aspect of the major connector.
- External finish line must be sharp and definite with a slight undercut to retain acrylic resin to the major connector.
- The angle, the finish lines form with the major connector should be less than 90 degrees.

Method of placement: Formed by placement of the wax during the waxing procedure and by carving the wax.

Location

1. Should extend onto the proximal surfaces of the teeth adjacent to the edentulous space.
2. Should begin at the lingual extent of the rest seat and continue down the lingual aspect of the minor connector on the proximal surface of the tooth.

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Internal finish lines

Are on the tissue side of the major connector.

Method of placement

- Formed from the relief wax used over the edentulous ridges on the master cast before duplication on which the framework will be waxed.
- A 24 to 26 gauge relief wax, placed under latticework or mesh minor connectors creates space for acrylic.
- The same relief waxes margins become the internal finish line.
- The ledge created by the margin of the wax must be sharp and definite.

Minor connectors that serve as approach arm for vertical projection or bar-type clasp

- Not required to be rigid unlike other minor connectors.
- It supports a gingivally approaching direct retainer.
- It should have a smooth, even taper from its origin to its tip.
- It must not cross a soft tissue undercut.

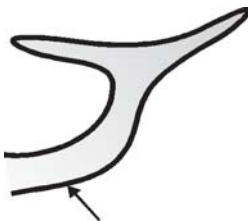


Figure 17: Approach arm

Functions of minor connector

1. Primary function is to join all the other components as clasps, rests, indirect retainers and denture bases to the major connector.
2. Aids in efficient functioning of all components.
3. Helps to retain rests in their rest seats, this serves to transfer forces occurring against the prosthesis down the long axis of the abutment teeth.

4. Minor connector aids in uniform distributing of the stresses hence, it should be rigid.
5. The minor connector distributes forces, on the edentulous ridge to the ridge and the remaining teeth by transferring it to several other minor connectors that serve as attachments for clasps, rests, or indirect retainers.
6. Preservation of bone.
7. In distal extension base the minor connector is part of the saddle hence, holds the artificial tooth in proper alignment.
8. Aids in retention, stability and support in a denture.

DEFINE A DIRECT RETAINER. LIST THE FUNCTIONS OF A CIRCUMFERENTIAL CLASP AND VARIOUS PARTS AS RELATED TO FUNCTION. DESCRIBE THE VARIOUS TYPES OF RETAINERS.

Definition

A direct retainer is that component that engages an abutment tooth and in doing so resists dislodging forces applied to a removable partial denture.

Classification

1. Intracoronal retainers.
2. Extra coronal retainers.
 - a. Circumferential or Aker's clasp
 - b. Vertical projection or Roach clasp

Parts of circumferential clasp

- a. Rest.
- b. Body.
- c. Shoulder.
- d. Reciprocal arm.
- e. Retentive clasp arm.
- f. Retentive terminal.
- g. Minor connector.

Functions of clasps

1. Retention,
2. Stability,
3. Support,

4. Reciprocation,
5. Encirclement,
6. Passivity.

Parts of extra coronal direct retainers and specific function

1. Rest: Function is vertical support
2. Minor connector: Function is stabilization by acting through guide planes placed on the proximal surfaces of abutment tooth extending from the prepared marginal ridge to the middle and gingival third of abutment tooth.
3. Clasp arms: Functions as stabilizing, retentive and reciprocating units.
 - Stabilization is attained by rigid portion of retentive arm and reciprocal arm along with the minor connector.
 - Reciprocation is attained by reciprocal arm
 - Retention is attained by retentive arm especially the retentive terminal.

The reciprocal clasp arm has three functions:

1. Reciprocation against the action of the retentive arm. During placement and removal, reciprocation is most needed as the retentive arm flexes over the height of contour. True reciprocation during placement and removal is possible only if guide planes are placed.
2. The reciprocal clasp arm should resist against horizontal forces so rigid clasp arms, rigid minor connectors and a rigid major connector should be used.
3. If reciprocal clasp arm rests on a suprabulge surface of an abutment tooth lying anterior to the fulcrum line it acts as an indirect retainer.

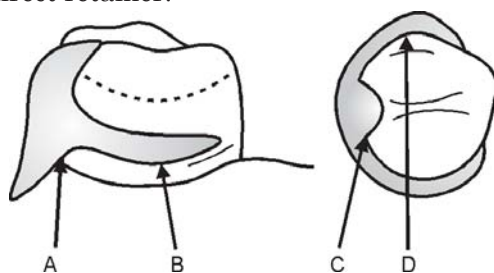


Figure 18: Parts of circumferential clasp: A. Minor connector, B. Retentive arm, C. Occlusal rest, D. Reciprocal arm

Types of clasps

1. Circumferential clasp which approaches the retentive undercut from an occlusal direction. (Occlusally approaching).
2. The bar clasp arm, which approaches the retentive undercut from a cervical direction. (Gingivally approaching).

Different types of circumferential clasps:

1. Cast circumferential clasp.
2. Simple circlet clasp.
3. Reverse circlet clasp.
4. Multiple circlet clasp.
5. Embrasure or modified crib clasp.
6. Ring clasp.
7. Fish hook or Hairpin clasp
8. Onlay clasp.
9. Combination clasp.

Different types of bar clasps:

1. T Clasp.
2. Modified T Clasp
3. Y Clasp
4. I Clasp and I Bar.

Circumferential clasps

Cast circumferential clasp

It is the method of choice for tooth supported partial dentures. The retentive arm should originate above occlusal half with the retentive terminal placed below height of contour and pointing occlusally.

Advantages

1. Good support, retention and reciprocation.
2. Easy to repair.
3. Less food retention compared to bar clasp.

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Disadvantages

1. Large amount of tooth surface covered that can cause decalcification and caries.
2. Minimum flexibility and cannot be used in distal extension bases.
3. Interferes with normal food flow pattern.
4. Not aesthetic.

Simple circlet clasp

Choice for tooth supported partial denture. The clasp approaches undercut from edentulous area and engages undercut opposite to edentulous space.

Advantages

1. Good support, stability, encirclement and very good passivity.
2. The most widely used clasp.

Disadvantages

1. Large amount of tooth surface covered that can cause decalcification and caries.
2. Minimum flexibility and cannot be used in distal extension bases.
3. Interferes with normal food flow pattern.

Reverse circlet clasp

Used when undercuts are present near the edentulous space. Ideally bar clasp is the choice but in situations as soft tissue undercuts where bar clasp cannot be used reverse clasp is used.

Advantage

Good for distal extension partial dentures.

Disadvantages

1. Difficult to obtain occlusal clearance where there is tight occlusion between upper and lower teeth.
2. Can cause food entrapment if occlusal rest is not well prepared.
3. Wedging effect as it is placed between two teeth.
4. Not aesthetic.

Multiple circlet clasp

- Consists of two opposing simple circlet clasps joined at the terminal end of reciprocal arms.
- Used as a splinting effect of weak tooth.

Disadvantages

1. Large amount of tooth surface covered that can cause decalcification and caries.
2. Minimum flexibility and cannot be used in distal extension bases.
3. Interferes with normal food flow pattern.
4. Not aesthetic.

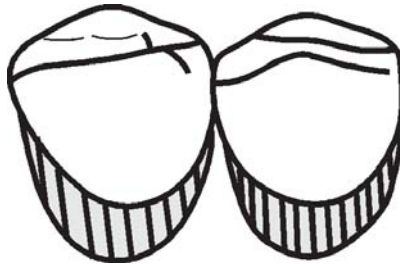


Figure 19: Multiple circlet clasp

Embrasure clasp

Consists of two simple circlet clasps joined at the body. The clasp crosses the marginal ridge and facial surface of both the teeth and engage undercuts on the opposite sides of the respective teeth. Used on side where there is no edentulous

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space. Embrasure clasps should have two retentive clasp arms and two reciprocal clasp arms, either bilaterally or diagonally opposed.

Disadvantages

1. Occlusal rest should be prepared on both the teeth.
2. Difficult to get occlusal clearance.
3. Large amount of tooth surface covered that can cause decalcification and caries.
4. Minimum flexibility and cannot be used in distal extension bases.
5. Interferes with normal food flow pattern.
6. Not aesthetic.

Indication

When spacing is present between two teeth.



Figure 20: Minor connector joining clasp assembly

Ring clasp

Ring clasp, encircles nearly all of a tooth from its point of origin. It is used when a proximal undercut cannot be approached by other means as in a distobuccal or distolingual undercut.

The ring-type clasp should be used on protected abutments as it covers such a large area of tooth surface.

Disadvantages

1. Not esthetic.
2. Large amount of tooth surface covered that can cause decalcification and caries.
3. Minimum flexibility and cannot be used in distal extension bases.
4. Interferes with normal food flow pattern.



Figure 21: Ring clasp

Fish hook or Hairpin clasp

It is a simple circlet clasp in which the retentive arm crosses the facial surface of the tooth and loops back in a hairpin turn to engage the undercut below its point of origin. The upper arm acts as a minor connector and is rigid; the lower arm is tapered and is flexible.

Disadvantages

1. Only can be used in tooth with adequate occlusogingival height.
2. There tends to be food accumulation between the upper and lower clasp arms.
3. The upper arm can cause occlusal interference in tight occlusion of upper and lower arch.
4. Caries prone.
5. Not aesthetic.
6. Large amount of tooth surface covered that can cause decalcification and caries.
7. Minimum flexibility and cannot be used in distal extension bases.
8. Interferes with normal food flow pattern.



Figure 22: Fish-hook clasp

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Onlay clasp

- It covers the entire occlusal surface with buccal and lingual clasp arms.
- Should be made in patients with good oral hygiene.
- Occlusal surface should be of gold or acrylic.

Indication: To correct occlusal plane discrepancies as in tooth tipping or rotation.

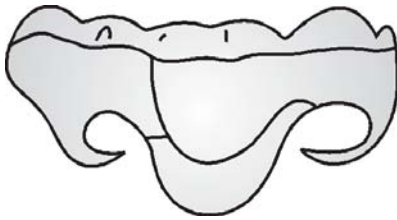


Figure 23: Onlay clasp

Combination clasp

Consists of a wrought wire retentive terminal and cast reciprocal arm. The wrought wire can be incorporated during wax up or can be soldered later on.

Indications

1. In distal extension partial denture with mesiobuccal undercut.
2. Can be used in deeper undercuts due to its flexibility.

Disadvantages

1. Requires additional work during laboratory fabrication.
2. Chances of breakage.
3. Easily distorted during normal handling.
4. Less bracing and stabilization compared to other circumferential clasp.

Advantages

1. Flexibility.
2. Adjustability.

3. Aesthetic advantage over other retentive circumferential clasp arms.
4. Minimum of tooth surface is covered compared to a cast clasp arm.
5. Fatigue failures are less compared to a cast, half-round retentive arm.

Bar clasp or Roach clasp

The bar clasp arm has been classified by the shape of the retentive terminal as T, modified T, I, Y, or almost any letter clasp arm.

They originate from the framework or base and approach the undercut from a gingival direction.

Flexibility is adjusted depending on the taper and length of the approach arm.

Advantage : It is more esthetic.

Disadvantages: Causes food entrapment.

Less bracing and stabilization compared to C- Clasp.

Rules of use

1. Approach arm should not impinge on soft tissues.
2. Minor connector attached to bar clasp should be rigid.
3. Approach arm should be uniformly tapered and should cross the gingival margin at 90 degrees.
4. Approach arm should extend to the height of contour.
5. The bar clasp is used only if the retentive area is adjacent to edentulous.
6. Retentive terminal of bar clasp should point toward the occlusal surface.
7. Bar clasp should be placed as low on tooth as possible.

I Bar is a part of the RPI system (rest, proximal plate, I-bar).

- This clasp assembly consists of a mesio-occlusal rest with the minor connector placed into the mesiolingual embrasure.
- A distal guiding plane, extending from the marginal ridge to the junction of the middle and gingival thirds of the

abutment, is prepared to receive a proximal plate. The proximal plate, in conjunction with the minor connector supporting the rest, provides the stabilizing and reciprocal aspects of the clasp assembly.

- The I-bar should be located in the gingival third of the buccal or labial surface of the abutment in 0.01 inch-undercut.

ENUMERATE VARIOUS FACTORS AFFECTING RETENTION IN DIRECT RETAINERS. ADD A NOTE ON GINGIVALLY APPROACHING CLASPS AND RPI SYSTEM.

Factors affecting retention

1. Flexibility of the clasp arm,
2. The depth that the retentive terminal extends into the undercut,
3. The amount of clasp arm that extends below the height of contour,
4. The amount of retention used should always be the minimum necessary to resist reasonable dislodging forces.

The retentive undercut has three dimensions:

- The buccolingual depth of the undercut expressed in thousandths of an inch. The less sharp this angle, the greater distance needed between the height of contour and the retentive terminal to achieve the same amount of retention.
- The distance between the survey line and the tip of the retentive clasp. This affects the clasp arm length, and in turn influences the flexibility of the clasp.
- Mesio-distal length of the clasp arm below the height of contour. The longer this measurement, the more flexible the clasp will be and the more important is the buccolingual dimension of the retentive undercut. The most variable factor in determining retention for a removable partial denture is clasp flexibility.

Flexibility is determined by

1. The length of the clasp,
2. The diameter of the clasp arm,
3. Its taper, the cross-sectional form and
4. The material from which the clasp is made.

Length

The greater the length of the clasp arm, the greater will be its flexibility. By doubling the length of a clasp arm, its flexibility is increased five times. Flexibility should be just adequate enough to provide retention.

Diameter

Flexibility is inversely proportional to the diameter of the clasp arm. A uniform taper in both thickness and width is essential for both the approach arm of a bar clasp and the retentive arm of a cast clasp. A clasp should be half as thick at the tip as at the origin.

Cross-sectional form

A round clasp has the ability to flex in all spatial planes, whereas a half-round clasp flexes only in a single plane.

Material

Chrome alloys have a higher modulus of elasticity than do gold alloys and are therefore less flexible.

Example: Chrome alloy clasps are placed in undercut of 0.01 inch. Gold alloys are placed in 0.015 inch.

As internal structure of wrought wire has greater ability to flex than the crystalline structure of cast alloy; a greater depth of undercut is required for a wrought wire clasp than for a cast clasp. Eg: 0.020 inch.

Details of bar or vertical projection clasps

- Vertical projection clasps approach retentive undercut from a gingival direction. Hence, called as push type of retention.

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- The flexibility of the bar clasp can be controlled by the taper and length of the approach arm. The greater the length and taper, the more the flexibility of the clasp.
- As the bar clasp is gingivally approaching, it is more esthetic than a circumferential clasp.

Disadvantages

1. Tendency to collect food debris.
2. Increased flexibility of the retentive arm, decreases bracing and stabilization. Additional stabilizing units need to be added to attain bracing and stabilization.

Rules for use

1. The approach arm of the bar clasp must not impinge on the soft tissue it crosses.
2. The minor connector that attaches the occlusal rest to the framework should be strong and rigid.
3. The approach arm must always be tapered uniformly.
4. The approach arm must never be designed to bridge a soft tissue undercut.
5. The approach arm should cross the gingival margin at a 90-degree angle.
6. The bar retentive clasp is used only when the retentive undercut is adjacent to the edentulous area from which the approach arm originates.
7. The reciprocal arm is positioned above the height of contour. The retentive terminal tip must point toward the occlusal surface.
8. The bar clasp should also be placed as low on the tooth as possible.

Types of Bar Clasps

T Clasp

- Used often along with cast circumferential reciprocal arm.
- The retentive terminal and its opposing terminal project laterally from the approach arm to form a T.

- Both terminals should point toward the occlusal surface of the abutment tooth.
- The retentive terminal must cross the height of contour to engage the retentive undercut, while the other terminal is placed on the suprabulge of the tooth.
- The approach arm contacts the tooth only at the height of contour.

Uses

1. In distal extension ridge with distobuccal undercut.
2. It reduces the torque to abutment tooth.
3. Can also be used for tooth-supported partial denture if the retentive undercut is located adjacent to the edentulous space.

Disadvantages

1. The T clasp can never be used when soft tissue undercut is present.
2. If used causes food retention and irritation to the lips and cheeks.
3. Never to be used when the height of contour is close to the occlusal surface of an abutment tooth.
4. Not to be used in mesiobuccal undercuts.

Modified T Clasp

The modified T clasp is a clasp in which only one terminal is present (only the retentive terminal). The nonretentive (usually mesial) finger is omitted.

Uses: Used on canines or premolars for esthetic.

Disadvantage

1. 180-degree coverage is not present which can compromise other functions of clasp such as bracing and reciprocation.
2. Can never be used when soft tissue undercut is present.

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3. If used causes food retention and irritation to the lips and cheeks.
4. Never to be used when the height of contour is close to the occlusal surface of an abutment tooth.
5. Not to be used in mesiobuccal undercuts.

Y Clasp

This is commonly used when the height of contour on the facial surface of the abutment tooth is high on the mesial and distal line angles but low on the centre of the facial surface.

The rest of the rules are same as T-clasp.

If recontouring can help to bring the survey line to the middle, a T-clasp can be used.

I Clasp and I Bar

Use: Used on the distobuccal surface of maxillary canines.

Disadvantage: Encirclement and horizontal stabilization are compromised.

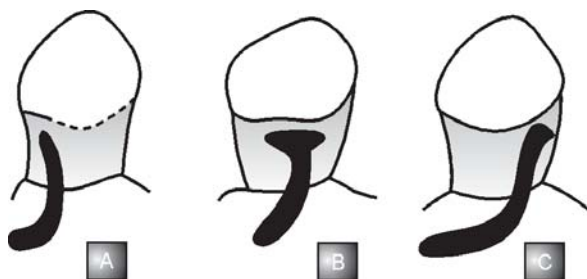


Figure 24: Types of clasp; A. I-bar, B. T clasp, C. Modified T clasp

RPI

The clasp system includes the three elements (Kratochvil's system): mesial rest, proximal plate and I bar.

Krol's criteria

1. Rest preparations are less extensive in the RPI system. The mesial rest prepared on molars and canines are often circular concave depressions prepared in the mesial marginal ridge.

2. Proximal plate is diminished in all directions and I bar retentive tips are placed mesial to the mesiodistal height of contour.
3. Occlusal force on extension base disengages proximal plate into gingival concavity and I-bar disengages into interproximal embrasure.

Tipped abutments and tissue impingement are treated with a further modification, the RPA clasp (rest, proximal plate and Akers clasp).

When the Akers clasp arm is used, careful attention is paid to relieving all undercuts except at the retentive tip.

The requirements of a partial denture clasp system (vertical support, horizontal stabilization, retention, reciprocation and passivity) are all met by the I-bar system.

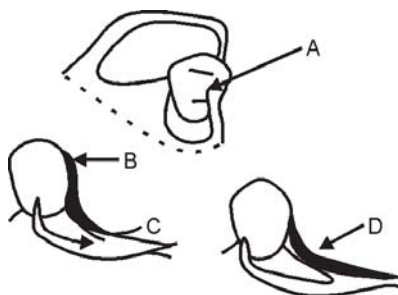


Figure 25: RPI system, A. Mesial rest, B. Proximal plate, C. I-bar, D. Krol's modification

DEFINE REST AND REST SEAT. GIVE ITS LOCATION. DESCRIBE VARIOUS TYPES OF RESTS AND THEIR FUNCTION.

Definition

Rest is a rigid extension of a fixed or removable partial denture, which contacts a remaining tooth or teeth to dissipate vertical or horizontal forces.

Any unit of a partial denture that rests on a tooth surface to provide vertical support is called a rest.

The prepared surface of an abutment to receive the rest is called the rest seat.

Depending on the location it is classified as

1. Occlusal rest.
2. Cingulum rest/ lingual rest.
3. Incisal rest.

Depending on the function it is classified as

1. Primary rest.
2. Secondary or Auxiliary rest.

Functions of rest

- Primary function is to provide vertical support for the partial denture.
- Additional functions are:
 1. Maintains components in their planned positions.
 2. Maintains established occlusal relationships.
 3. Prevents impingement of soft tissues.
 4. Directs and distributes occlusal loads to abutment teeth.
 5. Prevents cervical movement of partial denture.

Occlusal rest and rest seat

Shape

Triangular shape with the apex toward the centre of the occlusal surface.

Base of the triangular shape at the marginal ridge should be at least 2.5 mm for both molars and premolars.

Floor of the occlusal rest seat should be concave or spoon shaped.

Thickness

At the marginal ridge thickness should be minimum 1.5 mm.

Preparation should be within enamel.

Angulation

The angle formed by the occlusal rest and the vertical minor connector from which it originates should be less than 90 degrees.

Method of preparation

Occlusal rest seats in sound enamel can be prepared with diamond points of the size of Nos. 6 and 8 round burs or with carbide burs.

The larger diamond is used to prepare the marginal ridge and to establish the outline form of the rest seat. The smaller diamond point deepens the floor of the occlusal rest seat making it spoon shaped.

The unsupported enamel rods are planed by round bur of suitable size revolving at moderate speed.

Finally an abrasive rubber point is used to polish the preparation.

Function

As a shallow ball-and-socket joint, hence able to resist horizontal stresses to the abutment tooth.

Types

1. Interproximal occlusal rest seats.
2. Internal occlusal rests.

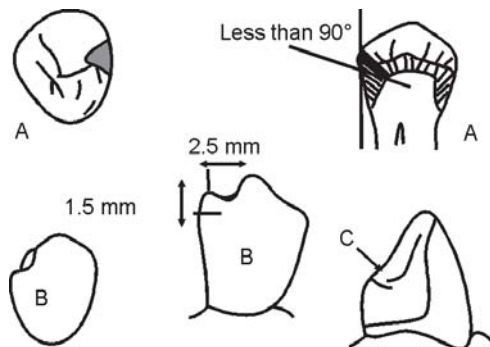


Figure 26: Rests, A. Occlusal rest, B. Incisal rest, C. Cingulum rest

Interproximal occlusal rest seats

Rest seats that are prepared as adjoining occlusal rest seats with preparations extending farther lingually.

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Advantages

1. Avoids interproximal wedging by the framework.
2. Prevents food entrapments.

Rules for preparation

1. Contact points of abutment teeth should be preserved.
2. Sufficient tooth structure removed to allow for adequate bulk.
3. Shaped so that occlusion will not be altered.
4. Sufficient space must be created to avoid interference with placement of rests.

Internal occlusal rests

Used in totally tooth-supported situations.

Enhances occlusal support and horizontal stabilization.

Occlusal support is derived from the floor of the rest seat and horizontal stabilization from the near-vertical walls.

Preparation: Rest should be parallel to the path of placement.

Tapered occlusally and slightly dovetailed to prevent dislodgement proximally.

Advantages

1. Aesthetically pleasing.
2. Can locate rest seat in a favourable position in relation to the horizontal axis of the abutment.
3. Retention is provided by a lingual clasp arm.
4. Use of a machined mandrel made of a chromium-cobalt alloy can be waxed into the crown or inlay pattern, invested and casted to a position parallel to the path of placement.

Rules for rest seat preparations

1. Should be prepared in enamel.
2. For effective functioning of rest guide plane preparations should be done.
3. The preparation of occlusal rest seats must follow proximal preparation, never precede it.

4. A fluoride gel should be applied to abutment teeth following enamel recontouring after the impressions are made.
5. Occlusal rest seat preparations in existing restorations are treated the same as preparations on tooth.
6. When a primary rest seat preparation is not adequate in function, a secondary occlusal rest should be used on the opposite side of the tooth to prevent slipping of the primary rest.
7. Occlusal rest seats in new restorations should be placed in the wax pattern.
8. Occlusal rest seats in crown and inlays are generally made somewhat larger and deeper than those in enamel.
9. Occlusal rest seats supporting tooth-borne dentures are made slightly deeper than those supporting distal extension bases.

Cingulum rests on canines

- Sufficient space must be present or created to avoid interference with placement of rests.
- A lingual rest is preferable to an incisal rest because it is placed nearer the horizontal axis of rotation (tipping) of the abutment.
- Lingual rests are more aesthetically acceptable than are incisal rests.
- Should be placed in enamel.

Shape of rest seat

A slightly rounded V.

Location

On the lingual surface at the junction of the gingival and middle one third of the tooth.

Apex of the V is directed incisally.

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Method of preparation

1. Preparation is started with an inverted cone-shaped diamond stone and progressing to smaller, tapered stones with round ends to complete the preparation.
2. All line angles should be eliminated.
3. Shaped, abrasive rubber polishing points, with pumice, is used for polishing.

Rules for preparation

- Prepared after finalizing the path of placement.
- The floor of the rest seat should be toward the cingulum.
- No enamel undercut, should be present.
- Ideally, it is best to place the rest seat in a cast restoration.
- The lingual rest can also be placed on the lingual surface of a cast veneer crown, a three-quarter crown, or inlay.
- Cast chromium-cobalt alloy rest seat attached to lingual surfaces of anterior teeth by composite resin cements have being tried.

Incisal rests and rest seats

- Incisal rests are placed at the incisal angles of anterior teeth and on prepared rest seats.
- Incisal rests are placed on enamel.
- Incisal rests are used as auxiliary rests or as indirect retainers.
- Can be placed in mandibular canines also.

Shape

Incisal rest seat is a rounded notch at an incisal angle or on an incisal edge, with the deepest portion of the preparation apical to the incisal edge. The rounded notch is bevelled labially and lingually and the lingual enamel is shaped to accommodate minor connector connecting the rest to the framework.

Size

Incisal rest seat is 2.5 mm wide and 1.5 mm deep.

Function

1. As auxiliary rest.
2. As indirect retainer to prevent rotational movement of the denture base.

Primary rest

It is a rest seat prepared to support the clasp assembly and act as a vertical support in preventing the displacement of the denture in cervical direction.

Secondary or auxiliary rest

Function as indirect retainer in distal extension partial dentures. The indirect retainers are placed opposite to fulcrum line anteriorly.



Figure 27: Rests 1. Primary rest, 2. Secondary rest

Factors influencing effectiveness of indirect retainers

1. Depends on effective function of the direct retainers.
2. To assess the position of placement of indirect retainer three areas must be considered:
 - a. Length of the distal extension base,
 - b. Location of the fulcrum line,
 - c. At what distance the indirect retainer should be placed.
3. Rigidity of the connectors supporting the indirect retainer.
4. Abutment tooth health and position.

Auxiliary functions of indirect retainers

1. Reduces the anteroposterior movement on the principal abutments.
2. Aids in horizontal stabilization when made parallel to the path of placement.
3. Splinting effect when used in the anterior teeth as supporting indirect retainers.
4. Aids in supporting major connector from settling into the tissues.
5. First visual indications for the need to reline in distal extension base partial denture.

Forms of indirect retainers

1. Auxiliary occlusal rest

In Class I-Bilateral rests on the mesial marginal ridge of the first premolars.

In Class II partial dentures- Placed on the marginal ridge of the first premolar tooth on the opposite side of the arch from the distal extension base.

2. Canine extensions from occlusal rests

A finger extension from a premolar rest is placed on the prepared lingual slope of the adjacent canine tooth. Applicable when first premolar serves as a primary abutment.

3. Canine rests

When mesial marginal ridge of the first premolar is too close to the fulcrum line an adjacent canine tooth is used.

4. Continuous bar retainers and linguoplate

In Class I and Class II partial dentures a continuous bar retainer or linguoplate may extend the effectiveness of the indirect retainer.

EXPLAIN THE VARIOUS IMPRESSION TECHNIQUES USED IN THE FABRICATION OF RPD. DESCRIBE THE FUNCTIONAL IMPRESSION TECHNIQUE USING KORECTA WAX.

The various impression techniques are

1. Single pressure free impression technique
2. Selective pressure impression technique
3. Physiologic or functional impression technique

Different Physiologic Methods (Dual Impression Technique) are

- a. McLean's method.
- b. Hindel's method.
- c. Functional relining method.
- d. Fluid wax method.

I. Single pressure free impressions

Are commonly made in association with tooth supported and some tooth tissue supported situations.

Impression materials used

1. Irreversible hydrocolloid (Alginate).
2. Reversible hydrocolloid (Agar).
3. Polysulfide.
4. Silicone rubber.

II. Selective pressure impression technique

- The physiologic impressions produce generalized displacement of the mucosa, whereas selective pressure directs the occlusal load to selected areas.
- Selective pressure impression technique equalizes the support between the abutment teeth and the soft tissue.
- Selective pressure technique helps to direct forces to the portions of the ridge capable of withstanding the force. This is obtained by providing relief in the impression tray with an acrylic bur in selected areas and permitting the impression tray to just allow space for impression material in other areas.

- The relief areas (as the crest of the ridge in mandibular, incisive papillae and median palatine raphe in maxillary) will be the least displaced, while at the areas the tray contacts, the tissues will have maximum displacement (such as buccal shelf area in mandibular, slopes of the ridge and posterior palatal space).
- Fluid wax functional impression technique and the selected pressure technique impressions displaces edentulous ridge in certain areas as selected and the master cast is altered to accommodate the altered ridge impression. Hence, this technique is referred to as the altered cast impression technique or the corrected cast impression technique.

Impressions materials used for selective pressure technique

Zinc Oxide-Eugenol Paste

- Zinc oxide-eugenol paste is of intermediate viscosity. Its main advantage is that it requires less time to make impression.
- Zinc oxide-eugenol paste is considered the impression material of choice if gross undercuts are not present.

Rubber base materials

- Polysulfide and silicone rubber base impression materials can be used.
- They are slightly more viscous than zinc oxide-eugenol paste; this viscosity can be altered by using higher percentage of light-bodied material in the mix.
- Requires more time to make the impression.
- Cannot be corrected by addition.
- An adhesive is required to ensure that the rubber adheres to the tray.
- Indicated for patients with bony undercuts in the edentulous ridge.
- Several holes needed to prevent excessive displacement of soft tissue. The holes will also prevent air traps.

III. Physiologic Impressions (Dual Impression Techniques)

McLean's physiologic impression

This technique is used in distal extension partial dentures (as in Kennedy's Class I and II situations) to record the tissues of the residual ridge that support a distal extension denture base in its functional form. This needs a dual impression technique.

Procedure

1. Custom impression tray is constructed over a preliminary cast of the arch.
2. Border moulding is carried out on the edentulous portion of the tray borders and a functional impression of the distal extension ridge is made with zinc oxide eugenol impression paste.
3. Hydrocolloid impression is made with a stock tray placed over the first impression, which is positioned in its functional position with finger pressure.

Disadvantage

Finger pressure cannot produce the same functional displacement of the tissue that biting force produces.

Hindel's method

The technique is same as McLean's method except that Hindel modified the stock tray for the second impression, which was provided with holes on both sides in the molar region so that finger pressure could be applied through the tray as the hydrocolloid impression was made.

Differences from McLean's technique

1. Hindel's technique was an anatomic impression of the ridge at rest made with a free-flowing zinc oxide-eugenol paste.
2. When the hydrocolloid second impression is made, finger pressure is applied through the holes in the tray to the

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anatomic impression. The pressure is maintained until the alginate sets.

3. Functional loading is achieved by finger pressure on the preliminary impression through the holes in the stock tray while making the second impression.

Disadvantages

1. The displaced or functional form technique can cause interruption of blood circulation with adverse soft tissue reaction and resorption of the underlying bone.
2. When the patient's teeth came together, the artificial teeth contact first and the remaining natural teeth contact only after the mucosa has been displaced. This is uncomfortable to many patients.

Functional relining method

In this technique the secondary impression is made after the framework is constructed so it is referred as functional reline. This technique adds a new surface to the tissue side of the denture base.

This can be done before insertion or later if excessive resorption is present.

Procedure

1. A soft metal spacer (Ash No. 7 metal) is adapted over the ridge on the cast before processing the metal denture base. After processing the metal is removed, leaving an even space between the base and the edentulous ridge.
2. Border moulding is done and impression is made with a low-fusing modelling plastic placed over the tissue surface of the denture base. The modelling plastic is tempered in a water bath and seated in the patient's mouth until an accurate impression of the ridge is made.
3. The entire procedure is done with the patient's mouth in a partially open position.

4. *Final impression:*

After the application of modelling plastic is complete 1mm of modelling plastic is scraped away uniformly from all over the crest of ridge.

Final impression is made with a free-flowing zinc oxide-eugenol impression paste. In case of excessive undercuts a elastomeric impression material is used.

Disadvantages: Occlusal discrepancies are present after the new denture base is processed.

Cannot establish previous occlusal contacts.

Fails to maintain the correct relationship between the framework and the abutment teeth during the impression procedure.

Fluid wax functional impression

The term fluid wax denotes waxes that have the ability to flow at mouth temperature.

Types of waxes that can be used:

- Iowa Wax, developed by Dr. Smith.
- Korecta Wax No. 4, developed by Drs. O.C. and S.G. Applegate.
- Korecta wax No.4 has better flow properties than Iowa wax.

Objectives of this technique:

1. To obtain maximum extension of the peripheral borders of the denture base.
2. To record the stress-bearing areas of the ridge in their functional form and remaining tooth in their anatomic form.

Uses of fluid wax technique

1. Used to make a reline impression for existing partial denture.
2. To correct the distal extension edentulous ridge portion as in altered cast technique.

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Procedure

1. **Impression tray** is made, attached to the framework after verifying fit of framework.
2. **Peripheral extensions of tray** are corrected after seating the tray in the mouth. The tray should be 1 or 2 mm short of the movable tissue.
The posterior extension of the tray should end at two-third the coverage of retromolar pad.
3. **Border moulding** the impression tray:
The mandibular distal extension tray is border moulded in two steps:
 - i. From the anterior extent of the buccal flange to the most posterior extent of the tray and
 - ii. The remainder of the lingual and distal lingual flange.
4. **Relieving tray**
As no relief was provided between the ridge and the tray during the fabrication of denture base, 1 to 2 mm of the tray is relieved for impression procedure.
5. **Impression procedure**
 - The fluid wax impression is made with the open mouth technique.
 - The impression wax is melted in a water bath maintained at 51 to 54 degree C within a container.
 - The wax is painted on to the tissue side of the impression tray with a brush.
 - Each time the tray is placed into the patient's mouth, it must remain in place for 5 minutes to allow the wax to flow and to prevent build-up of pressure, which can result in distortion.
 - After 5 minutes the tray is removed and the wax examined for glossy surface indicating adequate contact.
6. **Making the impression borders**
The peripheral extension of the impression tray should be short by 2 mm to develop a proper border seal with tissue movements done by the patient.

7. Buccal and distobuccal borders in mandibular impressions

Are obtained by asking the patient to open the mouth wide, which will activate the buccinator muscle and Pterygo-mandibular raphe and produce the desired border.

8. Lingual extension for a mandibular impression

Tongue is thrust into the cheek opposite the side of the arch being border moulded by the patient.

9. Distolingual extension

- The patient presses the tongue forward against the lingual surfaces of the anterior teeth.
- After the entire borders are copied satisfactorily the impression is replaced in the mouth for a final time for 12 minutes to ensure complete flow of wax and to release any pressure present.

10. New cast is poured immediately to prevent wax distortion.

Advantage: Can produce an accurate impression if properly done.

Disadvantages

- Time consuming.
- Can cause excessive tissue displacement if not done accurately.

WHAT IS THE IMPORTANCE OF DISTAL EXTENSION IMPRESSION PROCEDURE IN PARTIAL DENTURE? LIST FACTORS INFLUENCING SUPPORT OF DISTAL EXTENSION BASE. EXPLAIN IN DETAIL FLUID WAX IMPRESSION TECHNIQUE

Importance of distal extension impression procedure

1. If pressure free single impressions are used to fabricate distal extension partial denture than excess pressure is exerted onto the abutment tooth.
2. A dual impression technique equalizes forces on the edentulous ridge and abutment tooth.

3. Dual impression copies edentulous ridge in functional form and tooth in anatomic form.
4. Distributes load over large area.
5. Defines the peripheral extension of denture base accurately.

Factors influencing support of distal extension base

1. ***Quality of soft tissue covering ridge:***

A firm tightly attached mucosa can withstand better stress and render more support to denture than a flabby displaceable tissue.

2. ***Quality of bone supporting denture base:***

Cortical bone can resist vertical forces better than cancellous bone. The areas of denture bearing areas covered by cortical bone is utilised as primary stress bearing areas of that arch.

3. ***Design of partial dentures:***

An accurately designed partial denture with direct and indirect retainers placed in the right areas can give better stability, support and retention.

4. ***Amount of tissue coverage by denture base:***

Denture bases covering maximum surface area have uniform distribution of load.

5. ***Occlusal forces:***

A partial denture opposing natural teeth is subjected to more occlusal forces than opposing a complete denture or RPD.

To reduce the occlusal forces:

- Denture base need to have maximum coverage.
- Narrowing of food table of artificial tooth.
- Cutting efficiency can be improved on artificial tooth by adding sluiceways and grooves.

6. ***Stress bearing areas need to be utilised in maxillary and mandibular dentures:***

Maxillary: Buccal slopes of the ridge and palatine shelves resist lateral and vertical displacement of the prosthesis.

Mandibular: Buccal shelf area and slopes of residual ridge resist vertical and horizontal forces.

7. ***A perfect fit of the denture base with adequate coverage and proper peripheral extensions give better support to denture.***

Fluid wax functional impression

The term fluid wax denotes waxes that have the ability to flow at mouth temperature.

Types of waxes that can be used:

- Iowa Wax, developed by Dr. Smith.
- Korecta Wax No. 4, developed by Drs. O.C. and S.G. Applegate.
- Korecta wax No.4 has better flow properties than Iowa wax.

Objective of this technique

1. To obtain maximum extension of the peripheral borders of the denture base.
2. To record the stress-bearing areas of the ridge in their functional form and remaining tooth in their anatomic form.

Uses of fluid wax technique

1. Used to make a reline impression for existing partial denture.
2. To correct the distal extension edentulous ridge portion as in altered cast technique.

Procedure

1. *Impression tray* is made, attached to the framework after verifying fit of framework.
2. *Peripheral extensions of tray are corrected* after seating the tray in the mouth. The tray should be 1 or 2 mm short of the movable tissue.

The posterior extension of the tray should end at two-thirds coverage of the retromolar pad.

3. *Border moulding the impression tray:*

The mandibular distal extension tray is border moulded in two steps:

- i. From the anterior extent of the buccal flange to the most posterior extent of the tray and
- ii. The remainder of the lingual and distal lingual flange.

4. *Relieving tray:*

As no relief was provided between the ridge and the tray during the fabrication of denture base, 1 to 2 mm of the tray is relieved for impression procedure.

5. *Impression procedure:*

- The fluid wax impression is made with the open mouth technique.
- The impression wax is melted in a water bath maintained at 51 to 54 degree C within a container.
- The wax is painted on to the tissue side of the impression tray with a brush.
- Each time the tray is placed into the patients mouth, it must remain in place for 5 minutes to allow the wax to flow and to prevent build-up of pressure, which can result in distortion.
- After 5 minutes the tray is removed and the wax examined for glossy surface indicating adequate contact.

6. *Making the impression borders:*

The peripheral extension of the impression tray should be short by 2 mm to develop a proper border seal with tissue movements done by the patient.

7. *Buccal and distobuccal borders in mandibular impressions:*

Are obtained by asking the patient to open the mouth wide, which will activate the buccinator muscle and pterygo-mandibular raphe and produce the desired border.

8. *Lingual extension for a mandibular impression:*

Tongue is thrust into the cheek opposite the side of the arch being border moulded by the patient.

9. *Distolingual extension:*

- The patient presses the tongue forward against the lingual surfaces of the anterior teeth.
- After the entire borders are copied satisfactorily the impression is replaced in the mouth for a final time for 12 minutes to ensure complete flow of wax and to release any pressure present.
- New cast is poured immediately to prevent wax distortion.

Advantage: Can produce an accurate impression if properly done.

Disadvantages

- Time consuming.
- Can cause excessive tissue displacement if not done accurately.

Preparing original cast and pouring corrected cast:

1. Corrected cast impression can be done in 20 to 30 minutes.
2. The edentulous areas are outlined on the cast.
3. These outlined areas are removed with handsaw.
4. Knife-edged stone on lathe is used to make longitudinal retention grooves on cut surface of cast to provide mechanical retention for new portion of cast to be poured.
5. Framework is seated on sectioned cast and secured with modelling plastic. Impression must not contact cast.



Figure 28: Framework attached on sectioned case

6. Utility wax is used to bead impression to form land area, 2 to 4 mm below peripheral margins of impression and extending outward 3 to 4 mm from impression.

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7. Boxing wax is added around beading wax to confine dental stone.
8. Original cast is soaked in slurry water for 10 minutes and dentrite stone is poured into the beaded and boxed portion.
9. After the stone sets the altered cast is retrieved with the edentulous area recorded in functional form.

EXPLAIN IMPORTANCE OF MOUTH PREPARATION IN CAST PARTIAL DENTURE DESIGNING AND ADD A NOTE ON VARIOUS PROCEDURES AND ITS SIGNIFICANCE IN DESIGNING

Mouth preparation in RPD

Mouth preparation is part of the treatment planning phase carried out to enhance the success of the removable partial denture.

The order of procedures in mouth preparation

1. Surgical procedures.
2. Periodontal procedures.
3. Endodontic procedures.
4. Orthodontic realignment, if necessary.
5. Treatment of abused tissues.
6. Preparation of guide planes and rest seats.
7. Prosthetic rehabilitation.

Surgical procedures

1. Extractions

- a. Any tooth detrimental to the design of the partial denture.
- b. Residual roots tips should be extracted with minimum bone loss.
- c. Impacted teeth.
- d. Malposed teeth which is grossly extruded or drifted which cannot be corrected by restorations.

2. Cyst and odontogenic tumours

Confirm with roentgenogram and investigated by biopsy.

3. *Exostoses and tori*

If causing hindrance to the design of the removable partial denture a surgical removal is done with air-turbine handpiece at lower speeds (20,000 to 50,000 rpm). To prevent thermal damage to the bone adequate water irrigation is needed.

4. *Hyperplastic tissue*

Surgical excision by scalpel, curette, or electrosurgery.

5. *Muscle attachments and freni:*

Near to the alveolar crest should be corrected, if not can compromise retention of the removable partial denture.

Common muscle attachments that can cause this problem are mylohyoid, buccinator, mentalis and genioglossus muscles.

The maxillary labial and mandibular lingual freni are the most commonest of frenum interferences.

6. *Bony spines and knife-edge ridges.*

7. *Polyps, papilloma and traumatic hemangiomas*

8. *Hyperkeratoses, erythroplasia and ulcerations.*

All abnormal, white, red, or ulcerative lesions should be sent for biopsy.

9. *Dentofacial deformity.*

Surgical correction of a jaw deformity can be made in horizontal, sagittal, or frontal planes.

10. *Osseointegrated devices:*

Endosteal implants or fixtures constructed from titanium are placed under controlled oral surgical procedures if required for partial denture.

Periodontal procedures

The periodontal procedures follow surgical procedures.

Objectives of periodontal therapy:

1. Removal of all etiologic factors causing periodontal disease.

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2. Elimination of all pockets.
3. Creating physiologic gingival and osseous architecture.
4. Establishment of functional occlusal relationships.
5. Plaque control program and definitive maintenance schedule.

Evaluation of abutment tooth for periodontal health:

- Evaluating pocket depth especially in the abutment tooth.
- Check bleeding on probing, for sulcular health.
- The extent and pattern of bone loss.
- The degree of mobility present.
- Any traumatic occlusion.
- Diagnostic aids used are: Periodontal probe, mouth mirror, curved explorers, furcation probes, diagnostic casts and roentgenograms.
- Evaluating Pocket depth:
Periodontal probe is used circumferentially around each tooth and depths are recorded in distobuccal, mesial, mesiobuccal, distolingual, lingual and mesiolingual aspects of each tooth.

Treatment planning is divided into three phases:

<i>First Phase</i>	Initial disease control therapy.
<i>Second Phase</i>	Definitive periodontal surgery.
<i>Third Phase</i>	Recall maintenance.

First phase

Initial disease control therapy.

This phase constitutes reducing local etiologic factors by:

1. Oral hygiene instructions.
 2. Scaling.
 3. Root planing and polishing.
 4. Endodontics.
 5. Occlusal adjustment and
 6. Temporary splinting.
1. *Oral hygiene instructions:* Should be instructed to use disclosing wafers, soft nylon toothbrush, and unwaxed

dental floss apart from the normal oral hygiene instructions as correct brushing technique, etc.

2. *Scaling and root planing*: The use of ultrasonic instrumentation for calculus removal followed by root planing with sharp periodontal curettes is recommended which will result in complete calculus removal and root surface decontamination.
3. *Overhanging margins (of amalgam alloy and inlay restorations)*: Overhanging crown margins, and open contacts leading to food impaction should be corrected before definitive prosthetic treatment.
4. *Traumatic cuspal interferences*: Should be eliminated using grinding procedure to establish a positive planned intercuspal position that coincides with centric relation.

Interferences in working and non-working sides should be removed.

Second phase

Definitive periodontal surgery

After initial therapy is completed, the patient is re-evaluated for the definitive surgical phase.

Surgical procedures are indicated when:

1. Pocket elimination was not achieved by scaling and root planing.
2. Gingival recession.
3. Lack of attached gingiva.
4. Furcation involvement.
5. Underlying osseous defects.

Pocket elimination

Can be achieved by:

- a. Shrinkage.
- b. Surgical excision.
- c. Gingivectomy.
- d. New attachment procedures.

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Gingivectomy

Indications:

- a. Supra-bony pockets of fibrotic tissue exist.
- b. Absence of deformities in the underlying bony tissue with pocket.
- c. Pocket depth confined to the band of attached gingiva.

Contraindications

- a. If osseous deformities are present.
- b. If pocket depth traverses or approximates the mucogingival junction.
- c. In gross gingival recession.

The gingivectomy technique is carried out with appropriate cutting instruments.

Periodontal flap: Two commonest used flaps techniques are:

- a. Modified Widman Flap.
- b. Full-thickness mucoperiosteal flap.
- c. Reconstructive surgical procedures.

Modified Widman Flap: This is a more conservative surgical procedure than full-thickness flap.

Indications

- a. When periodontal pockets are 4 to 6 mm in depth.
- b. When osseous loss is primarily of the horizontal type.

Full-thickness flap: This can be replaced in its pre-surgical position, or can be apically replaced.

Indications

- a. When surgical area has pockets of 6 mm or more with osseous defects.
- b. In case crown lengthening is required.

Reconstructive surgical procedures: Commonly used procedures are:

- a. Laterally replaced flap.

- b. Edentulous area pedicle flap.
- c. Double papillae repositioned flap and
- d. Free gingival graft.

Indications

- a. In establishing a zone of attached gingiva on abutment teeth.
- b. In cases with less than 1 mm of attached gingiva.

Third phase

- a. Recall maintenance.
- b. Includes reinforcement of plaque control measures.
- c. Debridement of all root surfaces of supragingival and subgingival calculus and plaque by the dentist.
- d. A 3 to 4 month recall system.

Advantages of periodontal therapy

- 1. Elimination of periodontal disease enhances the long-term success of dental treatment.
- 2. Periodontium free of disease enhances restorative corrections.
- 3. Elimination of periodontal pockets establishes a normal gingival contour on the tooth surface.
- 4. Coronal contours and gingival margins of restorations can be placed with accuracy.
- 5. Aids in evaluating a tooth before a final decision is made to include them in the partial denture design.
- 6. Can analyse the degree of cooperation to be expected from the patient during the restorative phase.
- 7. Preservation of tooth, which could have otherwise failed.
- 8. Crown lengthening procedures enable the tooth to distribute forces more uniformly.

Prosthodontic procedures

Mouth preparation is done to suit a simple design.

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Conditioning of abused and irritated tissues are done when:

1. Mucosa covering the denture-bearing areas has inflammation and irritation.
2. Distortion of normal anatomical structures is present.
3. Burning sensation is present in any denture bearing area or other areas related to prosthesis placement.
4. In cases of ill fitting or poorly occluding removable partial dentures.

The fabrication of new prosthesis should wait till the oral tissues can be returned to a healthy state.

Steps in treatment procedure

1. A good home care program, such as rinsing the mouth three times a day with a prescribed saline solution.
2. Use of tissue conditioning materials:

They have to be lined on existing dentures after:

- a. Eliminating deflective or interfering occlusal contacts of old dentures.
 - b. Extending denture bases to proper form to enhance support, retention and stability.
 - c. Relieving the tissue side of denture bases at least 2 mm to provide space for an even thickness.
 - d. Applying the correct amount of material to provide support and a cushioning effect following the manufacturer's directions.
3. Three or four changes of the conditioning material are adequate, for the distorted tissues to assume their normal form.

Abutment teeth

- The abutment teeth are evaluated for the proposed path of placement, the areas of teeth to be altered and tooth contours to be changed and the location of rest seats.
- The rest seat preparations are carried out in the concerned abutment teeth as designed on the diagnostic cast.

ENUMERATE FACTORS AFFECTING DESIGN OF RPD AND ADD A NOTE ON DESIGN ASPECTS IN KENNEDY'S CLASS I SITUATIONS

Factors influencing design

1. A choice between FPD and RPD is made depending on the number of tooth missing, periodontal situation and patient choice.

If RPD is the line of treatment planned, then evaluate the:

- a. Occlusal relationship of remaining teeth.
 - b. Orientation of the occlusal plane.
 - c. Space available for restoration of missing teeth.
 - d. Arch integrity.
2. Need for abutment restorations.
 3. Response of oral structures to previous stress, periodontal condition of the remaining teeth, the amount of abutment support remaining and the need for splinting, etc. should be evaluated.
 4. Type of major connector to be used.
 5. Whether the denture is tooth supported, tissue supported or tooth tissue supported.

If it is a distal extension denture than following has to be assessed:

- a. Need for indirect retention.
 - b. Clasp designs that will best minimize the forces applied to the abutment teeth during function.
 - c. Type of base material used.
 - d. Secondary impression method to be used.
6. Materials to be used, both for the framework and for the bases.

Design aspects in Kennedy's Class I situation

Class I: (Bilateral distal extension)

In Class I removable partial dentures, abutment teeth are situated anterior to edentulous area and hence need support from soft tissue and the remaining teeth.

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Diagnosis and treatment planning includes abutment tooth evaluation and edentulous ridge evaluation.

Abutment tooth evaluation:

1. Periodontal health.
2. Crown and root morphologies and ratio.
3. Bone index area.
4. Location of the tooth in the arch.
5. Relationship of the tooth to other support units.
6. The opposing dentition.

Edentulous ridge area evaluation:

1. The quality of the residual ridge.
2. Denture base coverage.
3. Type and accuracy of the impression registration.
4. Fit of denture base.
5. The design of partial denture framework.
6. The occlusal load.

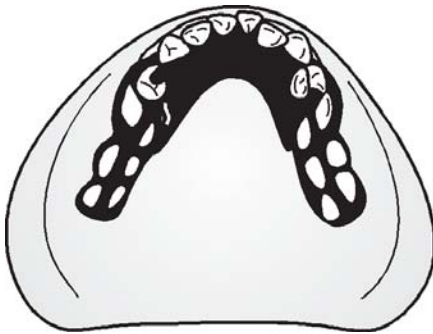


Figure 29: Kennedy's class I design

Ideal impression technique

Any physiologic impression technique or selective pressure technique.

Important factors in the impression for distal extension partial dentures:

1. The material should record the tissues covering the primary stress-bearing areas in their supporting form.

2. Tissues within the basal seat area other than primary stress-bearing areas must be recorded in their anatomic form and
3. The total area covered by the impression should be maximum, for uniform load distribution.

Essentials of partial denture design

1. Locating rest seat on principal abutment tooth. (Support areas).
2. Connecting the tooth and tissue support units by designing and locating major and minor connectors.
3. Designing direct and indirect retainers to:
 - a. Avoid direct transmission of tipping or torquing forces to the abutment.
 - b. Correctly position clasp assembly in definitive location on abutment tooth surfaces.
 - c. Provide retention against dislodging forces and be compatible with undercut location, tissue contour and esthetic desires of the patient.
4. Connecting the retention units to the support units.
5. Designing outline and joining the edentulous area to the already established design components.

Components of partial denture design

1. Major connector.
2. Minor connector.
3. Rests.
4. Direct retainers.
5. Reciprocal or stabilizing components (as parts of a direct retainer assembly).
6. Indirect retainers (if the prosthesis has one or more distal extension bases).
7. One or more bases, each supporting one to several replacement teeth.

Principles of designing for Class I removable partial dentures:

1. Support areas as rest seats.

2. Major and minor connectors: Commonest mandibular major connector in situations lower anterior teeth are weakened by periodontal disease with less lingual tissue space is linguoplate.
Commonest maxillary major connector is the full coverage palatal major connector. It is preferred because of its rigidity and greater stability without tissue damage.
3. Direct retainers retain the prosthesis against reasonable dislodging forces without damage to the abutment teeth and to aid in resisting any tendency of the denture to be displaced in a horizontal plane.
4. The circumferential and bar-type clasp retainers are mechanically effective and are more economically constructed than are intracoronal retainers.

Direct retention

Objectives of direct retention:

1. Restoration of function and appearance.
2. Preservation of the health.
3. Integrity of all the oral structures that remain.
4. Aid in close adaptation and fit of denture base against multiple, properly prepared guide planes.

Selection of clasp

Objectives

1. Clasp should have good stabilizing qualities.
2. Should remain passive until activated by functional stress.
3. Should permit minor amount of movement of the base without transmitting a torque to the abutment tooth.
4. Should be able to control stress transmitted to abutment tooth.

Design aspect

The most posterior teeth on each side of arch should be clasped.

- For distobuccal retention use T-bar.
- For mesiobuccal retention use 18 gauge wrought wire clasp or reverse circumferential clasp.

Depending on the amount of undercut

- Cast cobalt-chromium clasps for 0.010 inch of retentive undercut. (Not ideal to be used on mesiobuccal undercut on the posterior abutment tooth).
- Wrought wire clasps for 0.020 inches of retentive undercut. In case of excessive bone loss double clasping can be designed.

Ideal design of direct retainers

1. A Class I prosthesis requires only two **retentive clasp arms** one on each terminal tooth.
 - a. If a distobuccal undercut is present, the vertical projection clasp is preferred.
 - b. If a mesiobuccal undercut is present, a wrought wire clasp is indicated. (A cast circumferential type clasp should not be used).
 - c. The reciprocal or bracing arm must be rigid.

2. Stabilizing components

Are those rigid components that assist in stabilizing the denture against horizontal movement, hence distributing stresses equally to all supporting teeth without overworking any one tooth. The minor connectors that join the rests and the clasp assemblies to the major connector serve as stabilizing components.

3. Guiding planes:

The functions of guiding plane surfaces are as follows:

- a. To provide for one path of placement and removal of the restoration.
- b. To provide retention against dislodgement of the restoration when the dislodging force is directed other than parallel to the path of removal and also to provide stabilization against horizontal rotation of the denture.
- c. To eliminate gross food traps between abutment teeth and components of the denture.

Indirect retainers

An indirect retainer must be placed as far anteriorly from the fulcrum line as adequate tooth support permits.

Either a canine or premolar tooth should be used for the support of an indirect retainer.

An incisal rest or a lingual rest may be used on an anterior tooth, provided a definite seat can be obtained either in sound enamel or on a cast restoration.

MENTION AND JUSTIFY THE COMPONENTS INDICATED FOR KENNEDY'S CLASS I AND II RPD. HOW DOES IT DIFFER FROM CLASS III DESIGN?

Difference between Class I, II and Class III line of treatment.

1. The Class I type and the distal extension of the Class II type are mostly tissue supported.
Class III type is tooth supported.
2. Class I and II require dual impression technique, whereas Class III only needs pressure free single impression technique.
3. Class I and Class II need indirect retention.
4. As Class I and Class II are mostly tissue supported may need a base material that can be relined to compensate for tissue changes.
As Class III is tooth supported, tissue changes are unlikely hence metal bases can be used.
5. Type of direct retention for Class I and II need to be passive and should not flex except when engaging the undercut area of the tooth for resisting a vertical dislodging force and also able to dissipate stresses without harming the abutment tooth (Eg: combination clasp).
The amount of stress transferred to the supporting edentulous ridge(s) and the abutment teeth will be dependent on:
 - a. The direction and magnitude of the force,
 - b. The length of the denture base lever arm(s),
 - c. The quality of resistance (support from the edentulous ridges and remaining natural teeth),
 - d. The design.

Principles of design for Class I removable partial dentures

(Refer Figure 29)

1. Support areas as rest seats
2. Major and minor connectors: Commonest mandibular major connector in situations lower anterior teeth are weakened by periodontal disease with less lingual tissue space is Linguoplate.
Commonest maxillary major connector is the full coverage palatal major connector. It is preferred because of its rigidity and greater stability without tissue damage.
3. Direct retainers retain the prosthesis against reasonable dislodging forces without damage to the abutment teeth and to aid in resisting any tendency of the denture to be displaced in a horizontal plane.
4. The circumferential and bar-type clasp retainers are mechanically effective and are more economically constructed than are intracoronal retainers.

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1. Restoration of function and appearance.
2. Preservation of the health.
3. Integrity of all the oral structures that remain.
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Selection of clasp

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1. Clasp should have good stabilizing qualities.
2. Should remain passive until activated by functional stress.
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4. Should be able to control stress transmitted to abutment tooth.

Design aspect

The most posterior teeth on each side of arch should be clasped.

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 - Wrought wire clasps for 0.020 inches of retentive undercut.
- In case of excessive bone loss double clasping can be designed.

Ideal design of direct retainers

1. A Class I prosthesis requires only two **retentive clasp arms** one on each terminal tooth.
 - a. If a distobuccal undercut is present, the vertical projection clasp is preferred.
 - b. If a mesiobuccal undercut is present, a wrought wire clasp is indicated. (A cast circumferential type clasp should not be used).
 - c. The reciprocal or bracing arm must be rigid.

2. **Stabilizing components:**

Are those rigid components that assist in stabilizing the denture against horizontal movement hence distributing stresses equally to all supporting teeth without overworking any one tooth. The minor connectors that join the rests and the clasp assemblies to the major connector serve as stabilizing components.

3. **Guiding planes:**

The functions of guiding plane surfaces are as follows:

- a. To provide for one path of placement and removal of the restoration.
- b. To provide retention against dislodgement of the restoration when the dislodging force is directed other than parallel to the path of removal and also to provide stabilization against horizontal rotation of the denture.
- c. To eliminate gross food traps between abutment teeth and components of the denture.

Indirect retainers

- An indirect retainer must be placed as far anteriorly from the fulcrum line as adequate tooth support permits.
- Either a canine or premolar tooth should be used for the support of an indirect retainer.
- An incisal rest or a lingual rest may be used on an anterior tooth, provided a definite seat can be obtained either in sound enamel or on a cast restoration.

Occlusion

A centric relation record needs to be taken, as posterior tooth contacts are absent.

Tooth selection

- a. Smaller and teeth that are narrower buccolingually.
- b. Teeth should be positioned over the crest of the mandibular ridge when possible.
- c. Teeth modified if necessary to produce sharp cutting edges and ample escape ways.

Denture base

- a. The base should be designed with broad coverage so that the occlusal stresses can be distributed over as wide an area of support as possible.
- b. The extension of the borders must not interfere with functional movements of the surrounding tissues.
- c. A selective pressure impression should record the residual ridge in a functional form with altered cast technique.

Principles of design for Class II removable partial dentures

Ideal design

1. A Class II prosthesis should usually have three **retentive clasp arms**.
 - a. The distal extension side should be designed with the same considerations as for a Class I prosthesis.
 - b. The tooth-supported, or modification, side should have two retentive clasp arms one as far posterior and one

as far anterior as tooth contours and aesthetics permit. If a modification space exists on the dentulous side, the adjacent tooth should be clasped with simple circlet clasps into a distobuccal undercut for the posterior abutment and mesiobuccal undercut for the anterior abutment tooth.

2. **Bracing arms** should be rigid. Lingual plating can be substituted.

3. **Rests**

- Occlusal rests along with direct retainers.
- Positive rest seats along with indirect retention.
- Rest is prepared for maximum possible support for the prosthesis.
- Rest seats should be prepared to direct stresses along the long axis of the teeth.
- Rests should be placed next to the edentulous space generally.

4. **Indirect retention**

- a. To neutralize unseating or rotational forces.
- b. Should be located as far anterior to the fulcrum line as possible.
- c. Two indirect retainers should be used in a Class I design, whereas one placed on the side opposite to distal extension base is enough for Class II design.

The indirect retainers with positive rest seats to direct forces along the long axis of the tooth.

Depending on the span of edentulous ridge all the principles of Class I distal extension is applicable to Class II.

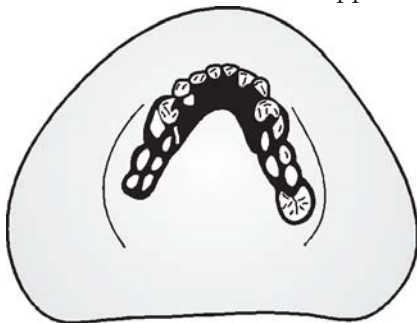


figure 30: Kennedy's class II design

Principles of design for Class III removable partial dentures

Edentulous areas are bounded anteriorly and posteriorly by abutments. They may be unilateral or bilateral.

- If no modification space exists, the teeth adjacent to the edentulous space should be clasped as for the dentulous side of a Class II, modification 1 arch. On the side where no space exists, clasping should be done with one clasp as far anteriorly as possible and one posteriorly positioned.
- If a modification space does exist on the opposite side of the arch, all four abutment teeth adjacent to the edentulous spaces should be clasped with the simplest type of clasp available.
- If one or both of the posterior abutment teeth are weak due to loss of bone, it may be advisable not to place retentive clasps on them but to place an occlusal rest for vertical support and nonretentive clasp arms for bracing against lateral movement.

1. *Direct retention*

- a. Retention can be achieved with much less potential harmful effect on the abutment teeth than with the Class I or II arch.
- b. The position of the retentive undercut on abutment teeth is not critical.



Figure 31: Kennedy's class III modification I

2. *Clasps*

- a. The quadrilateral positioning of direct retainers.
- b. The type of clasp selected is not critical.
- c. Bracing arms must be rigid.

3. *Occlusion*

Centric occlusion and centric relation should coincide with no interceptive contacts and with all eccentric movements in harmony with, the remaining natural teeth.

DISCUSS THE PROBLEMS THAT ARE ENCOUNTERED IN MAKING RPD FOR A KENNEDY'S CLASS I MANDIBULAR SITUATION. DESCRIBE THE STEPS IN THE DESIGN OF A KENNEDY'S CLASS I MANDIBULAR SITUATION.

Problems encountered in Kennedy's Class I situation of the mandibular arch

1. The tissue coverage is limited in the mandibular arch. The cast partial denture cannot cover the entire denture base areas as a complete denture can; hence the support offered by denture base is minimal compared to maxillary partial denture.
2. In Class I situation of the mandibular arch the commonest teeth that are remaining are the incisors, canines and, occasionally, the first premolars. It is difficult to select and place direct retainers without transmitting stress to the abutment tooth.
3. If only the lateral incisors are remaining, the partial denture becomes more tissue supported with less stability.
4. The direct retention depends on the periodontal situation of the remaining teeth. Weak teeth need to be splinted before taking support from them.
5. The amount of lingual tissue space present decides the selection of the type of major connector. In cases of high frenal attachments another alternative like labial bar has to be designed.
6. Bony spicules, knife-edge ridge with excessive resorption complicates the design aspect.
7. If mandibular tori exist, surgical correction needs to be done before the partial denture is made.
8. Enlargement of tongue, abnormal tongue movements complicate the partial denture design.

9. In case there is flabby displaceable tissue a pressure free impression is preferred. In case the flabby tissue can be excised its better to surgically correct and then proceed with partial denture treatment.
10. If lingually inclined anterior tooth cannot be corrected by altering or restorations, then a labial bar major connector is the choice.

Design principles

Class I. Bilateral edentulous areas located posterior to the remaining natural teeth In Class I removable partial dentures, abutment teeth are situated anterior to edentulous area and hence need support from soft tissue and the remaining teeth.

Principles of designing for Class I removable partial dentures:

1. Support areas as rest seats (Cingulum rest or mesial fossae rest on first premolars).
2. Major and minor connectors: Commonest mandibular major connector in situations lower anterior teeth are weakened by periodontal disease with less lingual tissue space is linguoplate.
3. Direct retainers retain the prosthesis against reasonable dislodging forces without damage to the abutment teeth and to aid in resisting any tendency of the denture to be displaced in a horizontal plane.

The circumferential and bar-type clasp retainers are mechanically effective.

The bar type clasp is a clasp of choice for aesthetics.



Figure 32: Kennedy's class I
(mandibular arch)

Direct retention

Objectives

1. Restoration of function and appearance.
2. Preservation of the health.
3. Integrity of all the oral structures that remain and
4. Aid in close adaptation and fit of denture base against multiple properly prepared guide planes.

Selection of clasp

Objectives

1. Clasp should have good stabilizing qualities.
2. Should remain passive until activated by functional stress.
3. Should permit minor amount of movement of the base without transmitting a torque to the abutment tooth.

Stabilizing components

Are those rigid components that assist in stabilizing the denture against horizontal movement, hence distributing stresses equally to all supporting teeth without overworking any one tooth. The minor connectors that join the rests and the clasp assemblies to the major connector serve as stabilizing components.

Guiding planes.

The functions of guiding plane surfaces are as follows:

1. To provide for one path of placement and removal of the restoration.
2. To provide retention against dislodgement of the restoration when the dislodging force is directed other than parallel to the path of removal and also to provide stabilization against horizontal rotation of the denture.
3. Should be able to control stress transmitted to abutment tooth.
4. To eliminate gross food traps between abutment teeth and components of the denture.

Kennedy's Class I (Mandibular arch with shallow ridge):

1. Incorporate maximum denture base coverage (Lingual plate).
2. Reduce the buccolingual width of the denture teeth.
3. Posterior-most teeth are not replaced if there is no opposing natural teeth occlusion.
4. Placing adequate direct and indirect retainers on the remaining tooth.

Components and their function

- Resistance to anterior movement of the saddles is provided by the distal surfaces of the canines, supported by incisors.
- The resistance to posterior movement is achieved by carrying the distal extension of the saddles as high up the ascending rami as possible.
- In addition, flexible clasps are fitted to the canines with bracing action, to provide additional resistance to posterior movement.
- In free-end saddle movement is prevented by clasps and saddle along with maximum coverage of major connector. In the lower, the retromolar pad area if covered by denture base will also provide resistance to those forces moving the denture.

Rotational displacement

In the case of the free-end saddle any force displacing the saddle will tend to cause rotation about tips of the direct retaining arms and these points, when joined by an imaginary line, form a rotational axis.

To prevent this rotation an indirect retainer is placed opposite to the fulcrum line.

For the indirect retainer to be effective the distance between indirect retainer and the fulcrum axis should be equal.

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Forces in distal extension base

Occlusal/vertical forces:

1. These forces need to be distributed uniformly and this is achieved by rests as occlusal, incisal or cingulum rest in tooth supported.
2. In distal extension bases the major connector and rest seats help distribute the load uniformly.

Horizontal lateral forces:

1. Lateral forces are applied to the teeth and the mucous membranes when mandible moves from side to side with teeth in contact, thus causing the denture to move.
2. Component distributing this force uniformly is the bracing arms placed on or above the survey lines on the lingual or palatal surfaces of the teeth.
3. The bracing arm is rigid enough to resist lateral forces.
4. It functions by disengaging from the tooth when the denture is withdrawn.

Indirect retainers

- An indirect retainer must be placed as far anteriorly from the fulcrum line as possible to prevent torquing or rotation of the denture.
- A canine or premolar tooth is commonly used for placing indirect retainer in the form of cingulum rest or occlusal rest.
- An incisal rest or a lingual rest as for lingual plate can also be used as indirect retention in cases of distal extension bases.

Designing steps in Class I

Stage 1: Classification of the support for each saddle

Reducing the occlusal load by:

1. Special impression techniques.
2. By the placing of occlusal rests away from the saddle so that more load is transmitted on the mucosa compared with the periodontium.

3. The use of stress-breaking devices.
4. Distributing the load widely.
5. Maximum coverage of denture base.
6. Placing occlusal rests in their correct positions to support the saddles.

Occlusal rests functions

1. Resist vertical forces of occlusion.
2. It transmits horizontal forces to the teeth.
3. Prevents food entrapment.
4. They may act as indirect retainers.

Stage II: The provision of bracing arms

1. Resisting horizontal forces takes place via the bracing arms/ reciprocating arms.
2. Placed on all the abutment teeth on or above the survey lines and are joined to the occlusal rests.
3. Bracing also occurs in an anteroposterior and lateral direction from connectors which are placed on the teeth.

Stage III: Direct retention

A Class I prosthesis requires only two retentive clasp arms one on each terminal tooth.

1. If a distobuccal undercut is present, the vertical projection clasp is preferred.
2. If a mesiobuccal undercut is present, a wrought wire clasp is indicated. (A cast circumferential type clasp should not be used).
3. The reciprocal or bracing arm must be rigid.

Aesthetics: Gingivally approaching clasp is to be preferred for aesthetic reasons.

Stage IV: Indirect retention

1. An indirect retainer must be placed as far anteriorly from the fulcrum line as adequate tooth support permits.
2. Either a canine or premolar tooth should be used for the support of an indirect retainer.

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3. An incisal rest or a lingual rest may be used on an anterior tooth, provided a definite seat can be obtained either in sound enamel or on a cast restoration.

Stage V: Connectors

Commonest mandibular major connector in situations lower anterior teeth are weakened by periodontal disease with less lingual tissue space is linguoplate.

Minor connectors These are small struts which join rests and clasps to the major connector. They support the denture against the occlusal forces and transmit loads to the natural teeth.

DEFINE SURVEYOR AND SURVEYING. LIST AIMS AND OBJECTIVES OF SURVEYING. ADD A NOTE ON FACTORS AFFECTING PATH OF INSERTION

Definition

Surveyor: Is a parallelometer, an instrument used to determine the relative parallelism of surfaces of teeth or other areas on a cast of the jaws.

Surveying: An analysis and comparison of the prominence of intraoral contours associated with the fabrication of a prosthesis.

It is the study of parallelism or lack of parallelism to select path of insertion so that restorations encounter least tissue/tooth interference and will provide adequate balanced retention.

Uses of surveyor

1. Surveying the diagnostic cast.
2. Recontouring abutment teeth on the diagnostic cast.
3. Contouring wax patterns.
4. Aids in placing guide planes.
5. Measuring depth of undercut on abutment tooth.
6. Surveying ceramic veneer crowns.
7. Placing intracoronal retainers.
8. Placing internal rests.
9. Machining cast restorations.
10. Surveying and blocking out the master cast.

Aims and objectives of surveying

1. To determine the path of placement and path of removal.

Path of placement: It is the direction in which a restoration moves from the point of initial contact of its rigid parts with the supporting teeth to its terminal resting position, with rests seated and the denture base in contact with the tissues.

Path of removal: It is the direction of restoration movement from its terminal resting position to the last contact of its rigid parts with the supporting teeth.

2. To survey proximal tooth surfaces adjacent to edentulous areas for the placement of guide planes to achieve a parallel path of insertion.
3. To locate and measure undercut areas of the abutment teeth for direct retention.
4. To determine soft and hard tissue areas of interference.
5. To determine the path of placement and to locate placement of retainers and artificial teeth aesthetically.
6. To evaluate and chart mouth preparation procedures as preparation of proximal tooth surfaces for guiding planes, reduce excessive tooth contours, and to eliminate interference in hard and soft tissues.

The areas to be relieved are outlined in red on the diagnostic cast. A trial procedure is done on diagnostic cast with the aid of surveyor so that mouth preparations can be done accurately.

7. To mark the height of contour on abutment teeth, by which the exact position of the retentive terminal can be identified. The location of height of contour can also help in the accurate placement of rigid connectors, nonretentive reciprocal and stabilizing arms.
8. Helps in tripoding the cast, thus the same path of insertion can be achieved every time. This can be used for future reference also. Tripoding is done by locating three dots or parallel lines on the cast, in the horizontal plane in relation to the vertical arm of the surveyor.

9. Contouring wax patterns: Is done during the phase of mouth preparation to maintain the proposed path of placement, which can be copied on to the cast restorations for abutment teeth.

10. Guiding planes on all proximal surfaces of wax patterns adjacent to edentulous areas can be made parallel to the proposed path of placement.

11. Surveying ceramic veneer crowns:

Ceramic veneer crowns wax patterns are surveyed for locating the path of placement, if extra coronal direct retainers have to be placed on them.

Before the final glaze is accomplished, the abutment crowns should be returned to the surveyor to ensure the correct contour of the veneered portions or to locate those areas that need recontouring.

12. Placement of intracoronal retainers (internal attachments)

Factors in placement of attachments:

1. A path of placement is selected in relation to the abutment teeth that will avoid areas of interference.
2. A trial recesses is prepared on the diagnostic cast for estimating the proximity of the recess to the pulp. A resin guide of the recesses is prepared to aid the preparation in the mouth.
3. Recesses can be carved in wax patterns, to place internal attachment, or recesses can be prepared in castings with the hand-piece holder.
4. Keyway portion of the attachment is placed in the casting before investing and soldering parallel to the other keyways.

13. Placement of internal rest seats.

The surveyor may be used with a handpiece attached to the vertical arm by means of a handpiece holder. Internal rest seats may be carved in the wax patterns or rest seat may be cut in the cast restoration with the handpiece. Preparing rest seat in the wax pattern is the best.

An internal rest provides a positive occlusal support to prevent the rotational movement of denture base. It also provides horizontal stabilization.

Type of rest seat:

In distal extension bases: Ball-and-socket, spoon-shaped occlusal, or non-interlocking rest is prepared.

In tooth borne situations: Dovetailed or interlocking internal rest can be prepared.

Tapered fissure burs are used to form the vertical walls and small round burs are used to cut recesses in the rest seat.

14. Machining cast restorations:

With handpiece holder attached, axial surfaces of cast and ceramic restorations can be refined by machining with a suitable cylindrical carborundum point. This aids in placing guide planes exactly parallel to each other.

15. Surveying the master cast:

Objectives

1. To select the path of placement following mouth preparations of guiding planes, retention, non-interference and aesthetics.
2. To measure retentive areas and to locate retentive clasp terminals in proportion to the flexibility of the clasp arm being used.
3. To locate areas of undesirable undercut which need to be blocked out.
4. To contour blockout material parallel to the path of placement before duplication.

Surveying achieves

- a. A prosthesis that can be easily placed and removed by the patient.
- b. A prosthesis that is well retained.
- c. A prosthesis that is aesthetic.

Factors affecting path of insertion

- a. Retentive undercuts.
- b. Interferences in maxilla and mandible.
- c. Guiding planes.
- d. Aesthetics.

Retentive undercuts

Retentive undercuts should be present on the abutment teeth at horizontal tilt. (Position in which the occlusal surfaces of teeth are parallel to the surveying table).

If retentive undercuts are not present then it should be created by

- Tilting cast.
- Full crowns.

Ideal retentive under cuts: 0.010 inch either mesiobuccal or distobuccal (cast chrome alloy can be used in these retentive undercuts for 0.020 inch undercut (8 gauge wrought wire combination clasp can be used).

Modification of retentive undercut: A tilt can be given to the cast to achieve better retention.

Interferences

In maxilla

1. Torus palatinus:
Alter the design of major connector or go for surgical correction if needed.
2. Bony undercuts:
Common area is buccal to posterior teeth, anterior edentulous ridge.
Tilt the cast to alter undercut if mild, else surgical intervention is required.
3. Tipping of teeth:
Buccal/Lingual
Clasp design needs to be altered, one can tilt the cast if tipping is mild, in excessive tipping restorations need to be placed.

In mandible

1. Lingual tori:
Surgical correction required.
2. Lingually inclined teeth:
Labial bar major connector design or cast restorations on the inclined tooth to be placed.

3. Undercuts:
Area lingual to retromolar pad, mylohyoid ridge area.
Relieving or surgical recontouring may be necessary.

Aesthetics

- Clasp arms should not be visible.
- Artificial tooth to be positioned properly.

Factors in aesthetics

1. Locating the accurate placement of clasp after selecting the ideal tilt, if survey line is high.
2. Positioning natural tooth after correcting all existing malocclusion and space closures by orthodontic movement, disking proximal surfaces or placing restorations.
3. If osseous defects are present ridge augmentation procedures should be carried out before replacing tooth.

Guide planes

1. Prepared on the proximal aspect of the abutment tooth adjacent to edentulous area.
2. Should be in intimate contact with the minor connector.
3. Help protect weak tooth.
4. Can be prepared on enamel surface or wax patterns.

EXPLAIN THE STEP BY STEP PROCEDURE OF SURVEYING MASTER CAST IN RPD

Step-by-step procedures in surveying

1. Surveying a diagnostic cast
2. Final path of placement.
3. Outlining design on diagnostic cast.
4. Tripoding the cast.
5. Surveying master cast.
6. Measuring retentive under cuts.
7. Out lining design on master cast with graphite pencil.

Surveying a diagnostic cast

- A. **Placement of cast:** Cast is positioned on the surveyor table with the occlusal surfaces of the teeth parallel to the platform.
- B. Relative parallelism of proximal tooth surfaces are determined:
- If parallelism is present in horizontal plane it is not needed to tilt cast to achieve parallelism.
 - If proximal surfaces are not in a parallel relation an anteroposterior tilt or lateral tilt of the cast is required.
 - In case tilting of the cast has not achieved the required parallelism guiding planes have to be prepared.
 - If the analysing rod contacts proximal surface at the marginal ridge only, recontouring can establish a guiding plane. (Recontouring areas are outlined in red).
 - If the analysing rod contacts proximal surface at the cervical area only of the abutment tooth a cast restoration is the only means of establishing a guiding plane.
- C. *Retentive areas:*
- The surveyor blade is made to contact buccal and lingual surfaces of abutment teeth to evaluate the amount of retention existing below their height of convexity.
 - Light source passed between the surveyor blade and the apical portion of the tooth surface confirms the amount of retentive undercut.
 - If no sufficient under cut is present in the abutment tooth then a lateral tilt can be selected.
 - While selecting a lateral tilt it should not disturb the earlier established anteroposterior tilt.
 - The final tilt selected should maintain parallel guiding planes and also provide for acceptable retention.

D. Interference:

Mandibular arch:

- a. To check lingual surfaces for bony prominences and lingually inclined premolar teeth if lingual bar major connector is the choice.
- b. If bilateral interference is present surgery or recontouring of lingual tooth surfaces, is required.
- c. If it is only unilateral, a change in the lateral tilt can avoid the interference. This tilt should be in harmony with retentive undercuts and guide planes.
- d. If not then the interference should be removed by means of contouring or restorations to the tilted tooth.

Maxillary arch:

- a. Interferences are usually found on buccally inclined posterior teeth and bony areas on the buccal aspect of edentulous spaces.
- b. Other areas are interference on the surfaces of abutment teeth that will be crossed by minor connectors and clasp arms as distal line angles of premolar abutment teeth and the mesial line angles of molar abutments.
- c. These interferences can either be blocked out, altered by tilt, clasp design can be selected depending on the interference, recontoured or cast restorations can be placed on the tooth with interference.
- d. Nonretentive and stabilizing clasp arms are best located between the middle third and gingival third of the crown rather than the occlusal third.

E. Aesthetics:

The path of placement determines the location of clasps and position of artificial teeth.

Depending on aesthetics the clasp designs can be modified as:

- a. Gingivally approaching bar clasp.
- b. Slightly placing the circumferential clasp arms cervically.
- c. Tapered wrought-wire retentive clasp arms.

Final path of placement

The final path of placement is the anteroposterior and lateral position of the cast, in relation to the vertical arm of the surveyor, which satisfies the guiding planes, retention, interference and aesthetics.

Marking the proposed design on diagnostic cast

The components selected are outlined on the diagnostic cast as major connectors, minor connectors, location of rest seat, direct retainers, indirect retainers and saddles.

Mouth preparations

- Areas to be altered as undercuts.
- Areas of remaining teeth to be modified for:
 - a. Guide planes.
 - b. Preparation of rest seats.
- All the areas to be modified are outlined in red on the diagnostic cast. The rest seats are shaded in red pencil.
- Trial mouth preparations as guide planes and rest seats can be done on the diagnostic cast. This helps to orient for accurate preparations in the patients mouth. (The surveyor blade can be used to do the trial preparations so that the angle at which the handpiece must be held to prepare the amount of tooth in the mouth is identified. The cut surface on the stone tooth is again outlined in red pencil).

Tripoding the cast

Objectives

- Helps to return working cast to the surveyor in the same relation as the proposed path of placement for shaping wax patterns, trimming blockout on the master cast, or locating clasp arms.
- For future reference.

Methods of tripoding

First method

1. Three widely divergent dots on the tissue surface of the cast are placed with the tip of a carbon marker, having the vertical arm of the surveyor in a locked position.
2. Then the dots are encircled with a coloured pencil for easy identification.
3. On returning the cast to the surveyor, it may be tilted until the tip of the surveyor blade again contacts the three dots in the same plane. This orients the cast to the original position of the cast.
4. Tiny pits can be formed in the cast instead of markings hence transferring this relationship to the refractory cast.

Second method:

1. Cast can be scored on two sides and the dorsal aspect of the base of the cast with a sharp instrument held against the surveyor blade.
2. Tilting the cast until all three lines are again parallel to the surveyor blade orients the cast to the original cast position.

Surveying the master cast

1. The master cast is surveyed as a new cast; the already prepared proximal guiding planes will indicate the correct anteroposterior tilt.
2. The lateral tilt will provide equal retentive areas on all principal abutments in relation to the planned clasp design.
3. The type of clasp should be planned depending on the undercut area, factors of flexibility, etc.
4. If any further undercuts are observed during the designing of clasp it should be blocked out.

Steps

1. Tripoding is done for master cast.
2. Analysing rod is replaced with carbon marker and the height of convexity and tooth and soft tissue contours are verified.

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Any areas of interference in placement of framework are marked so that it can be blocked out.

3. Measuring retention:

Undercuts are measured with an undercut gauge, provided with the surveyor. The amount of undercut is measured in hundredths of an inch.

Under gauges are of three types – 0.01, 0.02, 0.03.

- 0.01 inch – retention by cast retainers,
- 0.02 inch – retention by tapered wrought-wire,
- 0.03 is rarely used.
- The amount of retention can be verified by a source of light, which forms a triangle bounded by the surface of the abutment tooth on one side and the surveyor blade on the other side.

Retention is determined by:

- a. The magnitude of the angle of cervical convergence.
- b. The depth at which the clasp terminal is placed in the angle and
- c. The flexibility of the clasp arm.

4. Final design is drawn on the master cast:

Fine, graphite crayon pencil is used to outline the design. The graphite crayon pencil does not erase off or distort during duplication procedures.

5. Design transfer:

Is done with specific colour codes as

- Brown for metal contours.
- Blue for resin outline.
- Red for relief areas.
- Black for the height of contour.

After the final design is drawn the dentist sends the following items to the laboratory:

1. Properly prepared and articulated master cast.
2. Diagnostic cast with specific design drawn on it.
3. Work authorization order.

DRAW A DIAGRAM OF NEY SURVEYOR. LABEL ITS PARTS. LIST FUNCTION OF TOOLS IN SURVEYOR. DESCRIBE HOW RETENTIVE UNDERCUTS ARE LOCATED USING A MODEL SURVEYOR AND HOW THEY AFFECT THE PATH OF INSERTION

Parts of the Ney surveyor are:

1. Platform on which the cast holder is moved.
2. Vertical arm that supports the superstructure.
3. Horizontal arm from which the surveying tool suspends.
4. Surveying arm to which the special tools are attached.
5. Table to which the cast is attached (Cast holder or surveying table which permits movement in horizontal planes by ball and socket action).
6. Mandrel for holding special tools.

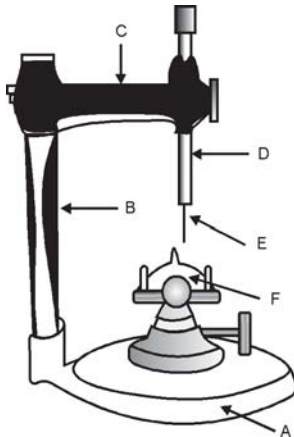


Figure 33: Ney surveyor; A. Surveying platform, B. Vertical column, C. Horizontal arm, D. Surveying arm, E. Mandrel with analysing rod, F. Cast holder

Tools in surveying

1. Analysing rod or paralleling tool.
2. Carbon rod or marker.
3. Undercut gauges.
4. Wax knife.

Analysing rod

1. This tool is used to check the parallelism of surfaces of tooth.

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2. Check undercuts in soft and hard tissues.
3. Check height of contour.

Carbon marker: A carbon marker replaces analysing rod to mark:

1. Survey lines.
2. Other area to be modified located by analysing rod.

Undercut gauges: Are used to identify specific amount and location of undercut on abutment tooth.

Undercut gauges are of three types – 0.01, 0.02, 0.03.

0.01 inch – retention by cast retainers

0.02 inch – retention by tapered wrought-wire.

0.03 is rarely used.

The amount of retention can be verified by a source of light, which forms a triangle bounded by the surface of the abutment tooth on one side and the surveyor blade on the other side.

Wax knife

1. Used to eliminate or block out undercuts.
2. To carve waxed up cast restorations for guide plane placement.
3. Locating path of placement.

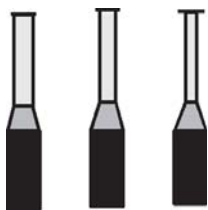


Figure 34: Undercut gauges

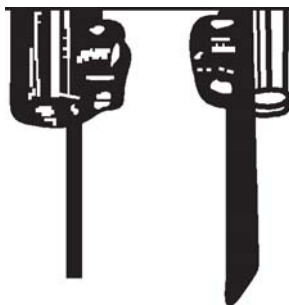


Figure 35: Analysing rod and carbon marker



Figure 36: Wax knife

Surveying a diagnostic cast

Placement of cast

Cast is positioned on the surveyor table with the occlusal surfaces of the teeth parallel to the platform.

Relative parallelism of proximal tooth surfaces are determined

1. If parallelism is present in horizontal plane, it is not needed to tilt cast to achieve parallelism.
2. If proximal surfaces are not in a parallel relation, an anteroposterior tilt or lateral tilt of the cast is required.
3. In case tilting of the cast has not achieved the required parallelism, guiding planes have to be prepared.
4. If the analysing rod contacts proximal surface at the marginal ridge only, recontouring can establish a guiding plane. (Recontouring areas are outlined in red).
5. If the analysing rod contacts proximal surface at the cervical area only of the abutment tooth a cast restoration is the only means of establishing a guiding plane.

Retentive areas

1. The surveyor blade is made to contact buccal and lingual surfaces of abutment teeth to evaluate the amount of retention existing below their height of convexity. The apical angle is called the angle of cervical convergence.
2. Light source passed between the surveyor blade and the apical portion of the tooth surface confirms the amount of retentive undercut.
3. If no sufficient under cut is present in the abutment tooth then a lateral tilt can be selected.
4. While selecting a lateral tilt it should not disturb the earlier established anteroposterior tilt.
5. The final tilt selected should maintain parallel guiding planes and also provide for acceptable retention.
6. The same is established on master cast.

Surveying a cast for direct retention

Factors determining the amount of clasp retention

1. Size of the angle of cervical convergence.
2. Placement of clasp terminal in relation to angle of cervical convergence.
3. Flexibility of the clasp arm.

Factors in retention related to abutment tooth

1. Height of contour cervical to which the surface converges. A line is marked with a carbon marker at the greatest circumference of abutment tooth. This line was referred to by Kennedy as the height of contour.

Cummer used it as a guide in the placement of retentive and non-retentive clasps.

DeVan divided the line into two as suprabulge, above the line and infrabulge, below the line.

Ideal placement of clasp arms:

Areas cervical to the height of contour are used for the placement of retentive clasp arms and areas occlusal to the height of contour is used for the placement of non-retentive reciprocating or stabilizing components.

Flexible components as clasp tips are to be placed gingivally to the height of contour and rigid components above height of contour.

If these guide lines are not achieved when the cast is placed at horizontal plane then only the cast should be tilted to find uniform retentive areas.

This new path of placement should also accommodate all factors as absence of undercuts, the location of vertical minor connectors, the origin of bar clasp arms and the denture bases. The clasp should have only a passive relationship to the teeth except when a dislodging force is applied.

2. Guide planes prepared aids in retention and easy placement and removal of prosthesis too. Relative uniformity of retention.

Factors affecting flexibility of clasp arms

1. Length of clasp arm.
 - The longer the clasp arm, the more flexible it will be.
 - The length of a circumferential clasp arm is measured from the point at which a uniform taper begins.
 - The retentive circumferential clasp arm should be tapered uniformly from its point of origin.
 - The length of a bar clasp arm is measured from the point at which a uniform taper begins at its point of origin from a metal base.
 - A bar clasp arm though longer than a circumferential clasp arm has less flexibility because of its half-round form.
2. Diameter of clasp arm.
 - The greater the diameter of a clasp arm, the less flexible it is if all other factors are equal.
 - The taper should be uniform, for the clasp to function properly.
3. Cross-sectional form of clasp arm.
 - Half-round form only flexes in one direction where as the round form is flexible in all directions.
 - Cast clasps are half round in form- hence less flexible and more used in tooth borne situations.
 - A retentive clasp arm on an abutment adjacent to a distal extension base requires a clasp with universal flexibility.
4. Material used for clasp arm. Material flexibility is proportionate to their bulk. Cast gold partial dentures need bulk to be rigid where as chromium alloys have greater rigidity with less bulk.

Reciprocal-stabilizing cast clasp arm

A reciprocal-stabilizing clasp arm should be rigid.

Its average diameter must be greater than the average diameter of the opposing retentive arm.

A reciprocal arm should be tapered in one dimension only, hence waxing of patterns is required.

Criteria for selecting a given clasp design

1. Proper diagnosis and treatment plan should be established.
2. Depends on the classification as tooth supported or tissue supported.
3. Depends on the amount of retentive undercut and if mesiobuccal or distobuccal.
4. Depends on aesthetics.
5. Function and limitations of clasp designs must be evaluated.
6. Clasp design must be biologically and mechanically acceptable.
7. Clasp design should perform the specific functions of support, stabilization, reciprocation and retention.

EXPLAIN THE THREE BASIC THEORIES BY WHICH FORCES ACTING ON RPD ARE DISTRIBUTED BETWEEN SOFT TISSUE AND TEETH

In a Class III arch which is tooth supported, a single impression can record the teeth and soft tissue. As the edentulous ridge does not offer support, it can be recorded in its anatomic form. As rotational forces do not occur, indirect retention or flexible direct retention is not required. Hence a Class III design is the simplest of design.

The problems encountered are in the Classes I and II arches and to some extent in the Class IV arch.

Many methods and impression techniques are present for equalizing support from the edentulous ridge and the remaining teeth.

These different methods gave rise to various design philosophies.

Three basic philosophies, which are supposed to distribute the forces acting on a partial denture between the soft tissue and the teeth, are:

1. ***Stress equalization.***
2. ***Physiologic basing.***
3. ***Broad stress distribution.***

Stress equalization / stress-directing

Philosophy

The resiliency of the tooth secured by periodontal ligament in an apical direction is not comparable to the greater resiliency and displacability of the mucosa covering the edentulous ridge. This difference in the amount of displacability between tooth and tissue causes the forces to be transmitted to the abutment teeth as the denture bases are displaced in function.

Rectification

This school of thought believed that the rigid connection between the denture bases and the direct retainer on the abutment teeth is damaging and if some type of stress director or stress equalizer is used it can counter this harmful effect.

Types of stress equalizers

1. Movable joint between the direct retainer and the denture base.
2. Flexible connection between the direct retainer and the denture base.

Movable joint: In the movable joint type falls the hinges, sleeves and cylinders and ball-and-socket devices.

They permit both vertical movement and hinge action of the distal extension base, which prevent direct transmission of tipping forces to the abutment teeth. (Dalbo attachment and the Crismani attachment).

These attachments are available as:

- Prefabricated (More lasting and accurate and are available in chrome).
- Custom made.

Flexible connection: This category includes wrought-wire connectors, divided major connectors and other flexible devices permitting movement of the distal extension base.

Advantages

1. The stress equalizer design needs only minimal direct retention.
2. Equalizes forces between tooth and edentulous ridge. (Sum of its resiliency and that of the periodontal ligament is equal to the resiliency of the mucosa).
3. Used in distal extension bases.
4. As it prevents the tipping forces on the tooth, there is less bone resorption about the tooth.
5. Reduces chances of relining or rebasing as intermittent pressure against the mucosa causes stimulating effect on the underlying bone and soft tissue which reduces chances of bone resorption.

Disadvantages

1. Fragile.
2. Construction is complex.
3. Expensive.
4. Difficult to repair.
5. Some amount of lateral forces is transmitted to ridge, which can result in resorption and settling of denture.
6. If thickness of metal in the hinge is used to prevent lateral movement, the prosthesis becomes bulky and annoying to the patient.
7. This design has the fewest advocates.

Physiologic basing

Philosophy

(Is same as for stress director but rectification is different).

The resiliency of the tooth secured by periodontal ligament in an apical direction is not comparable to the greater resiliency and displacability of the mucosa covering the edentulous ridge.

This difference in the amount of displacability between tooth and tissue causes the forces to be transmitted to the abutment teeth as the denture bases are displaced in function.

Rectification

The equalization is accomplished by physiologic basing, or lining, of the denture base.

Method

The physiologic basing is produced by displacing or depressing the ridge mucosa during the impression-making procedure and copying the tooth in its anatomic form, or by relining the denture base after it has been constructed.

Impression techniques as McLean's, Hindel's, fluid wax functional impression and selective pressure impression all displace the mucosa during the impression procedure and records soft tissue in its functional form and tooth in its anatomic form.

Modifications in design

The artificial teeth of a removable partial denture constructed from a tissue-displacing impression will be positioned above the plane of occlusion when the denture is not in function.

To permit movement of the partial denture from the rest position to the functioning position, the direct retainers must be reduced in number and also designed with minimal retention.

Advantages

1. The intermittent base movement has a stimulating effect on the underlying bone and soft tissue, which is likely to produce less resorption and hence chances of relining and rebasing are less.
2. Design is simple with minimal retention requirements.
3. Lightweight prosthesis.
4. Minimal maintenance and repair.
5. As there is only a passive placement of the clasps, forces transmitted to the abutment tooth are less.

Disadvantages

1. Stability against lateral forces is less.
2. As the artificial teeth are above the occlusal plane, premature contacts between the opposing teeth and the denture teeth are present which is uncomfortable for many patients.
3. Indirect retention is less.
4. Broad stress distribution:
5. This school of partial denture design believes that excessive forces to the remaining teeth and residual ridge can be prevented by distributing forces over as many teeth and soft tissue area as available.

Broad stress distribution

The partial denture based on this philosophy uses additional rests, indirect retainers, clasps and broad coverage denture bases.

Advantages

1. Uniform distribution of forces over a wide area.
2. Decreased bone resorption.
3. Lateral forces are better distributed than other designs.
4. Less expensive.
5. Less distortion.
6. Chances of breakage are less.
7. Good horizontal stabilisation.
8. No frequent relining.

Disadvantages

1. Maximum tooth and soft tissue coverage can cause tissue irritation,
2. Increased bulk,
3. Less patient comfort.

LIST VARIOUS PARTS OF RPD. EXPLAIN WITH DIAGRAM AND LIST FUNCTIONS OF EACH COMPONENT IN DETAIL.

Components of a typical removable partial denture are:

1. Major connector.
2. Minor connector.
3. Rests.
4. Direct retainers.
5. Indirect retainers in case of distal extension bases.
6. Saddles for replacement of teeth.

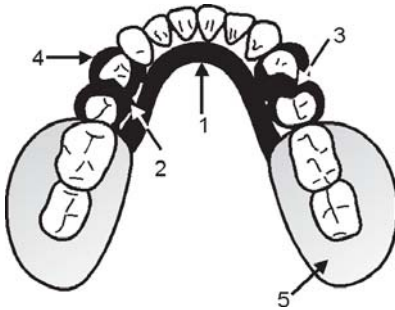


Figure 37: Components of RPD,
1. Major connector, 2. Minor connector,
3. Rests, 4. Direct retainers, 5. Tooth
replaced on saddle framework

Functions of each component

Major connector

A major connector is the unit of the partial denture that connects the parts of the prosthesis located on one side of the arch with those on the opposite side. It is that unit of the partial denture to which all other parts are directly or indirectly attached.

Functions of major connector

1. Major connectors must be rigid to transfer forces uniformly over the entire supporting structures.
2. Prevents movement of the denture base by its rigidity.
3. Aids the other components of the partial denture to function effectively.

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Minor connectors

The primary function of a minor connector is to join clasps, rests, indirect retainers and denture bases to the major connector.

Four types of minor connectors

1. That join the clasp assembly to the major connector.
2. That join indirect retainers or auxiliary rests to major connector.
3. That join the denture base to the major connector.
4. That serve as an approach arm for a vertical projection or bar-type clasp.

Functions of minor connector

- a. Distributes the stresses that occur against certain components of the partial denture to other components hence minor connectors need to be rigid.
- b. Distributes forces, on to the ridge and the remaining teeth.
- c. Aids in maintaining proper function of other components.

Stabilizing components: Minor connectors that join the rests and the clasp assemblies to the major connector.

Function:

Stabilizes the denture against horizontal movement.

Rests

Are placed in the rest seats prepared on the occlusal surface of the abutment tooth.

Types

Occlusal rest, lingual rest and incisal rest.

Functions of rest seat

1. Provides vertical support for a removable partial denture.

2. Maintains components in their planned positions.
3. Maintains established occlusal relationships by preventing settling of the denture.
4. Prevents impingement of soft tissues.
5. Directs and distributes occlusal loads to abutment teeth.
6. Can act as indirect retainer (Cingulum/Incisal rest) in distal extension partial denture.
7. Joined rest in spacing of tooth can prevent food impaction.
8. Thus rests serve to support the position of a partial denture and to resist movement in a cervical direction.

Factors affecting function of rest seat

1. Improper preparation of rest seat:
Rest seat should be triangular shape with the apex toward the centre of the occlusal surface.
The rest seat depth at marginal ridge of the abutment tooth must be at least 1.5 mm thick.
The angle formed by the occlusal rest and the vertical minor connector from which it originates should be less than 90 degrees so that occlusal forces can be directed along the long axis of the abutment tooth.
2. Fabrication defects causing unseating of rest seats.
3. If sufficient space is not created to avoid interference while placement of rests.

Internal occlusal rests

Occlusal support is derived from the floor of the rest seat.

Horizontal stabilization is derived from the near-vertical walls.

The form of the rest should be parallel to the path of placement, tapered occlusally and slightly dovetailed to prevent dislodgement proximally.

Functions

1. Occlusal support and horizontal stabilization.
2. Permits location of the rest seat in a more favourable position in relation to the “tipping” axis of the abutment.
3. Retention is provided by a lingual clasp arm.

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Direct retainers

Definition

A direct retainer is that component that engages an abutment tooth and in doing so resists dislodging forces applied to a removable partial denture in a horizontal plane.

Classification

- Intracoronal retainers.
- Extra coronal retainers.

Extra coronal retainers are classified as

- Circumferential or Aker's clasp.
- Vertical projection or Roach clasp.

Functions of clasps

1. Retention.
2. Stability.
3. Support.
4. Reciprocation.
5. Encirclement.
6. Passivity.

Extra coronal direct retainers

Parts and specific function:

1. Rest in clasp assembly gives vertical support.
2. Minor connectors function is stabilization.
3. Clasp arms functions are stabilization, retention, and reciprocation.
4. The reciprocal clasp arm has three functions:
 - a. Reciprocation against the action of the retentive arm.
True reciprocation during placement and removal is possible only if guide planes are placed.
 - b. The reciprocal clasp arm resist against horizontal forces.
 - c. Can function as indirect retainer if placed anterior to the fulcrum line.

Effectiveness of clasps depend on:

1. Depth of the undercut engaged.

2. Cross-sectional shape, size, length, position of clasp and frictional resistance between the enamel and the clasp arm of the clasp.
3. The modulus of elasticity of the alloy.
4. Angle of the incline plane of the tooth surface.
5. Mobility of the tooth.

Guiding planes:

1. Provides for one path of placement and removal.
2. Provide retention against dislodgement of the restoration.
3. Provide stabilization against horizontal rotation of the denture.
4. Eliminates food entrapment between abutment teeth and components of the denture.

Indirect retainers

An indirect retainer must be placed as far anteriorly from the fulcrum line as possible to prevent torquing or rotation of the denture.

A canine or premolar tooth is commonly used for placing indirect retainer in the form of cingulum rest or occlusal rest.

An incisal rest or a lingual rest as for lingual plate can also be used as indirect retention in cases of distal extension bases.

Saddles

These are parts of the denture, which replace the lost alveolar bone and the teeth.

If the saddle is tooth-supported at each end (bounded saddles) the area of the saddle is unimportant and can be as small as is practicable.

In the case of saddles without a posterior tooth (free-end saddles) support must come from the soft tissues and the alveolar bone, together with the tooth at the anterior end of the saddle hence should be of maximum coverage.

Components need to resist various forces and support the partial denture to prevent its displacement.

Functions of components

In a bounded saddle, antero-posterior movement is resisted by the teeth themselves.

In the case of an anterior saddle, additional resistance is also obtained by clasps passing round the teeth.

In free-end saddle it is prevented by clasps and saddle along with maximum coverage of major connector. In the lower, the retromolar pad and in the upper, the tuberosity will also provide resistance to those forces moving the denture.

Rotational displacement In the case of the free-end saddle any force displacing the saddle will tend to cause rotation about tips of the direct retaining arms and these points, when joined by an imaginary line, form a rotational axis.

To prevent this rotation an indirect retainer is placed opposite to the fulcrum line.

For the indirect retainer to be effective the distance between indirect retainer and the fulcrum axis should be equal.

WHAT ARE VARIOUS FORCES ACTING ON RPD? ENUMERATE DIFFERENT METHODS IN WHICH STRESSES ARE CONTROLLED IN RPD

Forces acting on RPD can be divided as:

1. Vertical forces.
2. Lateral forces.
3. Anteroposterior forces.

Factors influencing the forces

1. Depending on the denture such as tooth-borne, mucosa-borne or tooth-and-mucosa-borne the type of forces alter.
 - a. A tooth-borne denture will resist all types of loads better and provide the most efficient mastication.
 - b. Depending on the number of natural teeth, more the natural teeth the better the distribution of forces.
 - c. If distal extension type, generally the canines and incisors are left which cannot provide sufficient

support due to the inclination of their palatal or lingual surfaces, unless suitable restorations are made with cingulum or incisal rest seats prepared in them.

2. Depending on the opposing arch (If it is a denture opposing a RPD or natural teeth opposing RPD). If it is natural teeth opposing RPD the load applied to the denture will be at the maximum.
3. There must be sufficient space for occlusal rests to be adequately seated to transmit the loads imposed on the denture effectively to the abutment teeth. The rest seat should always be prepared on the enamel.
4. If the saddle areas are extensive, the design should be altered so that the loads applied to denture are transmitted via the soft tissues.

Vertical dislodging forces are

- a. Gravity, in upper dentures only.
- b. Sticky foods, both upper and lower dentures.
- c. The tongue.

How vertical loads can be controlled in different designs

Kennedy's Class I Mandibular arch with shallow ridge:

- a. Incorporate maximum denture base coverage (Lingual plate).
- b. Reduce the buccolingual width of the denture teeth.
- c. By not replacing the posterior most teeth if no opposing natural teeth occlusion.
- d. Placing adequate direct and indirect retainers on the remaining tooth.

Kennedy Class III type:

- a. The adjacent two teeth on either side of the edentulous space should be given occlusal rest to make it tooth supported. This can distribute the load uniformly. If any of the abutments are weak with bone resorption seen radiographically than the saddle need to be made mucosa borne.

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- b. The palatal and cingular slopes of canines form an inclined plane, causing the vertical load applied through a rest to incline in an angle to the palatal surface instead of transmitting the force along its long axis. This situation also needs a mucosa borne denture.

Kennedy's Class II design with two modification spaces:

- a. Here the distal extension area will be mucosa-borne while the modification spaces will be tooth borne.
- b. When a natural tooth is loaded vertically it intrudes into the alveolus by about 20 μm but mucosa loaded vertically displaces up to 500 μm this difference is not considered in the designing aspect, the abutment teeth can fail in the long run.

This different behaviour of these different tissues has a profound effect on the design of connectors between saddles of partial dentures.

What ever may be the situation a tooth-borne denture is better in resisting vertical loads than a mucosa-borne design.

In such situations mucosal borne dentures with stress breaking principle can be used.

Lateral forces

These forces or loads are imposed during lateral movements of the mandible and also during normal mastication; they vary depending on the tooth form, tooth area and the design of the occlusion.

Great lateral loads present

- 1. When cuspal interference exists.
- 2. When occlusion is not proper.

Lateral loads are resisted by

- 1. Lingual and palatal surfaces of the teeth.
- 2. Buccal surfaces, if clasps incorporating bracing elements in the functional arms are fitted.
- 3. The lingual, palatal and buccal surfaces of the ridges.

Designing to resist lateral loads

Kennedy Class I upper with well-formed ridges, deep sulci and a high, broad palate.

- Well-developed ridges of the saddle areas could provide good resistance to lateral movement of a denture. If the remaining teeth can also efficiently made to withstand lateral loads by placing occlusal rest the design is ideal.
- A mucosa borne denture with stress breaking principle can be used.

Kennedy Class I upper with poor, atrophic ridges, shallow sulci and a broad, flat palate.

- Here the ridges are unable to withstand lateral loads so the only option is to make the denture with more of mucosa support with all the palatal surfaces of the teeth covered by the denture to brace it against lateral movement.
- Additional bracing is also obtained from the rigid parts of the clasp arms.

Kennedy Class III modification 1 case with sound tooth:

- The occlusal load is supported by rests.
- Lateral loads can be accepted by these teeth and resistance to lateral movement can be enhanced by direct retainers and reciprocals on the buccal and palatal aspects.
- The occlusal rests prepared on teeth also provide resistance to lateral loads.
- Here the design is tooth borne.

Kennedy Class III modification 1 with weak abutment teeth which are periodontally involved:

- The design should be mucosa borne with the palatal aspects of all the standing teeth covered to gain sufficient resistance.
- In case of modification spaces with isolated tooth, designing should include guiding surfaces or guide planes on the proximal and lingual aspects of the abutment teeth, which effectively prevents rotational movements of dentures.
- When designing a denture to resist lateral movement, care must be taken that no individual abutment tooth is

subjected to too much load either in a direct lateral direction or in the form of a rotary one.

Anteroposterior forces

These, like lateral loads, are best resisted by the remaining natural teeth, resisted by the soft tissues via a large labial flange or an extension of a lower denture on to the anterior slope of the ascending ramus.

Groups of teeth provide the most satisfactory resistance to anteroposterior loads applied to a denture.

Kennedy Class III modification 1:

- The resistance to anterior movement of this denture is provided by the distal surfaces of the canines, reinforced by the four incisors. This group of teeth are capable of resisting all the anterior loads.
- Posteriorly-directed loads are similarly resisted by the mesial surfaces of the first molars, which are buttressed by the second molars. In this case anteroposterior type of movement is well resisted.

Kennedy Class I free-end saddle mandibular dentures:

- Resistance to anterior movement of the saddles is provided by the distal surfaces of the canines, supported by incisors.
- The resistance to posterior movement is achieved by carrying the distal extension of the saddles as high up the ascending rami.
- In addition, flexible clasps are fitted to the canines with bracing action, to provide additional resistance to posterior movement.
- In Kennedy Class I maxillary dentures a well-defined tuberosity and hamular notch both resist backward movement but if either of these is absent, then buccal arms on the canines may be necessary.
- The distal surfaces of the canine teeth and the anterior slope of the palate provide adequate resistance to anterior movement.

The Kennedy Class II case:

- For resistance to posterior movement bracing is designed by carrying a rigid connector to the other side of the mouth and firmly clasping the teeth on that side.
- The canine on the side of the free-end saddle is also clasped and the denture carried round it and up its lingual surface and the posterior aspect of the saddle is carried on to the ascending ramus, adequate resistance to posterior movement can be provided.
- The carrying of sublingual bar, or lingual plate, to the opposite side of the mouth provides more resistance to lateral movements.

Kennedy Class IV cases:

- Posterior movement is resisted by a labial flange on the mesial surfaces of the upper canines while the anterior movement of the denture can be resisted by the slope of the palate and by carrying the denture around the palatal aspects of the canines.
- More resistance can be gained by clasping the last molar teeth, which are situated some distance from the fulcrum.

Factors which help to improve retention and there by enhance force distribution:

1. The use of clasps (direct retainers).
2. Flexibility of clasps.
3. The use of undercuts existing naturally or by using restorations.
4. Guiding surfaces (or guide planes).
5. Adhesion and cohesion, increased in mucosa-borne dentures by covering as large an area as possible.
6. Indirect retainers.
7. Arranging teeth in proper occlusion.

Harmful effects of wrongly designed mucosa-borne dentures

1. If maximum coverage is not utilised, it overloads the area which is covered.

2. If insufficient lateral bracing against the natural teeth or slopes of the ridges, are present it displaces the denture and causes trauma of the mucosa by friction.
3. By fitting a denture which accepts the first occlusal contact on closing, the entire load is taken on the denture but little or none on the natural teeth this overloads the mucosa and underlying alveolar bone. This result in resorption of the alveolar ridge leading to an inaccurate fit of the denture base.
4. Gross cuspal interference and locking of the occlusion resulting in the denture being dragged across the mucosa.

EXPLAIN STEPS IN LABORATORY PROCEDURE FOR FRAMEWORK CONSTRUCTION OF CAST PARTIAL DENTURE

Laboratory procedures

Needed items for construction of the removable partial denture

1. Properly prepared and articulated master cast.
2. Diagnostic cast with specific design drawn on it.
3. Work authorization order.

Transfer of design from diagnostic cast to master cast

Design transfer is to convey the outline of the proposed prosthesis from the diagnostic cast to master cast.

Re-tripoding the master cast

When the three marks are in the same horizontal plane as that of the diagnostic cast, the table is securely locked with the re-tripoded master cast.

Height of contour

A carbon marker is used to place the height of contour line on involved teeth and soft tissue areas on the re-tripoded cast.

Design transfer

This is done with specific colour codes as:

- a. Brown for metal contours.

- b. Blue for resin outline.
- c. Red for relief areas.
- d. Black for the height of contour.

Block out and Relief

Block out: Is elimination of undesirable undercut areas on the cast to be used in the fabrication of the removable partial denture.

Relief: Is the procedure of placing a sheet of wax in strategic areas on a master cast to be duplicated so that a refractory cast can be made.

Done on both hard and soft tissues to achieve desired path of insertion.

Cast preparation

Beading the outline of major connector on the cast

Beading: Is scoring a cast with a sharp instrument or bur in any desired area to provide a seal between the finished prosthesis and the soft tissue.

- The outline of the major connector will be scraped on the maxillary cast to the depth of half of the diameter of a No. 2 round bur. This ensures a positive contact against the palatal tissues and prevents food packing beneath the major connector.
- Beading is not done on the mandibular major connector.

Application of model spray on the cast

- Model spray deposits a film on the cast that protects and seals the design throughout the blockout and duplication process.
- Done after the design is transferred.
- The sprayed cast is dried for 5 minutes.

Blockout technique

Composition of block out wax:

One sheet of soft baseplate wax with one stick of green inlay wax.

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Technique

Melted wax is applied with a spatula. Blockout wax should not be placed in clasp tip areas, guiding planes and above the contour line.

Types of block out

- a. Tapered / Shaped / Formed Blockout.
- b. Parallel Blockout.
- c. Arbitrary Blockout.

Tapered / Shaped / Formed blockout

- In case of tapered blockout the blade-like device used will be tapered (usually 2 to 4 degrees) or can be positioned to provide a range of taper by placing the cast on a specific area of the base.
- Tooth-tissue-borne dentures can be given a tapered blockout to allow freedom of movement in function.

Parallel blockout

- The blade surface will normally be perpendicular to the surveyor base.
- All tooth-borne partial dentures are blocked out parallel to the path.

Arbitrary blockout

- Areas of undercut not involved with the framework should be blocked out as to prevent distortion during duplication.
- Areas of gross soft tissue undercuts are blocked out with soft wax or clay.
- To save finishing time a very small amount of wax can be flown over the major connector area.
- When infrabulge clasp arms are used, soft tissue undercuts in the area of the approach arm are blocked out.

Wax contouring

- Excess wax is removed from beneath the height of contour and shaped using a warmed blade.

- The blockout wax in the clasp tip area is contoured with hand instruments to provide a slight ledge apical to the clasp tip.
- This ledge helps in the placement of the wax pattern at the correct position in the undercut area.

Relief

1. A 1 mm thickness of the relief wax is placed under the retentive meshwork for acrylic resin to flow on the cast with a hot spatula. A small square wax of 2 mm is removed with a blade held at 90 degrees to the cast for a tissue stop.
2. One margin of the relief wax is used to develop a sharp, definite internal finish line of the framework. The finish line must have a uniform depth of at least 1 mm and be no closer than 2 mm from the abutment teeth.
3. The blade is held at 90 degrees to the surface of the cast to develop a internal finish line that is sharp with the metal-resin junction at right angles.

Laboratory procedures

Sprue guide placement

A small metal, resin, or wax tapered cylinder is placed on the master cast in the exact position where the main sprue will be placed on the refractory cast.

Duplication

Impression

- The blocked out master cast is placed on the base of a duplicating flask.
- The duplicating flask has a metal base on which the master cast is fixed. The metal base aids in cooling of the agar.
- Agar at the proper temperature is poured into the flask. This flask is cooled in a regulated cooling tank for an hour.
- The flask is then disassembled and the master cast is removed.

Refractory cast

- Gypsum-bonded investments, are poured into the mould for Type IV/ gold partial denture.
- Phosphate bonded investments are used for chrome-cobalt alloy.
- After the refractory material sets the cast is removed and placed in a drying oven at 93°C.
- When dry, the cast is trimmed to within 6 mm of the proposed design.

Beeswax dip: The cast is dried in a hot air oven at 82 to 93°C for 1 hour, dipped into beeswax at 138 to 149°C for 15 seconds and set immediately on end to allow all the excess wax to run off.

Transfer of design to the refractory cast

Placement of wax pattern design on refractory cast: For retentive clasp arms, patterns with a width/thickness 2:1 is to be used.

For reciprocal clasps, patterns that are roughly square (width / thickness ratio 1:1) can be used.

Waxing technique

1. Gluing the pattern to cast with a mixture of acetone and plastic pattern scraps mixed to a watery consistency.
2. This glue is painted on the design outline with a fine brush and dried for a few seconds and the needed pattern is adapted.
3. The prefabricated patterns adapted on the cast should not distort while removing it from the card or while placing it.
4. The pattern is placed on the refractory cast with a modified tip of eraser that is wedged shaped.
5. Once the plastic patterns are placed they must be joined together with wax (blue inlay wax).
6. This wax is used to seal margins of the major connector, wax the minor connectors, rests and also reinforce the areas where the retentive meshwork joins the major connector.

Spruing the framework

Types:

- a. Single sprue (Ticonium)
 - b. Multiple sprues (Gold castings and chrome-cobalt alloys).
- Sprue size used should be uniform.

Auxiliary sprues: Are used when the framework is large, so that sufficient molten metal reaches the area. They should be one-third to one-fourth the dimension of the major sprues. The smaller sprue should be connected to the main sprue in a gentle curve.

Investing the refractory cast

Two-part mould:

1. The refractory cast is dipped in slurry water to prevent water absorption from first paint on layer.
2. Then a thin 3 to 4 mm layer of investment material is painted on the waxed refractory cast to ensure that no voids are present.
3. After the first layer sets, an investment ring is placed to accommodate the refractory cast.
4. The second part of investment material is mixed and placed in the ring.

Mould storage:

1. Some alloy systems only place the mould in the burnout furnace. (Without the ring).
2. Others burn out the mould with the ring in place.
3. The sprue lead, of metal or plastic, is removed and the entrance is cleared of any debris or sharp edges. The moulds are normally stored in a plastic bag to keep them from completely drying out till it is placed in the burnout furnace.

Burn out

Furnaces: Either electric or gas with electronic adjustment of time and temperature according to the alloy manufacturer's specifications.

Casting

Induction casting:

1. Alloys are melted using gas and oxygen to 1093°C. Oxyacetylene mixture is available for castings requiring higher heat.
2. The casting machine is set to the manufacturer's directions to include the revolutions per minute of the casting arm and the temperature required to start the machine.
3. An uncontaminated crucible with the proper amount of alloy is melted by activating the alternating current.
4. Once the alloy is reached the desired temperature, casting machines is set to cast. The alloy can be viewed through the protective lens of the casting machine.

Casting recovery

After the casting is complete, the mould is removed and allowed to cool. After adequate cooling, mould is broken and casting is retrieved.

The first layer of investment is removed by sand blasting. After examining for defects, finishing procedures are done.

Finishing the framework

1. Sprue Removal: With high-speed lathes and large abrasive disks, the sprues are cut off.
2. Rough Finishing and Shaping: The major connector is shaped and then rubber wheeled to a "satin" finish. The entire framework is contoured to its final finish.
3. Minimum finishing and polishing of rests, retentive clasp tips, guiding plane and minor connectors are done.

Fitting the frame work

Fit checking: Silicones, disclosing wax or commercial dies are used to locate improper seating of framework on the master cast or on the duplicate cast and carefully finished with fine stones.

Common areas requiring adjustment

- The area of the clasp tip undercuts passing the height of contour.
- Rest seat areas.
- Guide planes.

Final finishing

Rag and felt wheels are used on the high-speed lathe to apply the final polish.

Ultrasonic cleaning is commonly used to remove all traces of the polishing materials.

Sectioning and re-soldering the framework: If the framework does not fit the design well it can be sectioned and soldered later. Minor connectors and some major connectors can be sectioned and soldered with precious metal solder or non-precious brazing alloys with the electro-soldering device.

Adjusting occlusion: The seating of rest seat is ensured with an opposing cast and suitable jaw relation records.

Wrought wire retentive clasp arms

Common materials used- Precious alloys as gold, palladium, platinum, silver or non-precious alloys as stainless steel, nickel-chromium, nickel-chromium-cobalt.

Gauge: 17 to 20 gauge.

Attachment of wrought wire by

1. Embedding the wire in the resin of the denture base.
2. Including in the wax-up of the framework.
3. Attaching the clasp by soldering it to the framework.

In the finished frame work:

1. The surfaces of clasps and mandibular major connectors should be highly polished and free from pits and other irregularities.

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2. The taper of clasps, should be uniform and free from nicks and notches.
3. The major connector should be rigid enough not to bend under finger pressure.

ENUMERATE STEPS IN CLINICAL PROCEDURE FOR FITTING THE FRAMEWORK OF A CAST PARTIAL DENTURE

Clinical procedures

Objective

1. To fit the framework to the teeth.
2. To adjust the framework to the opposing occlusion.

Steps in fitting frame work to the teeth

Use of disclosing media: To locate small areas interfering with the fit of framework.

Types of disclosing media used:

- Jeweller's rouge dissolved in chloroform and painted on the metal.
- Commercially available disclosing waxes.

Differentiate between:

- Normal wiping away of wax.
- A wax tear caused by its sticking to the tooth surface.
- The show-through of metal caused by pressure spot.

Advantages of commercial disclosing medium:

1. Easier to use than Jeweller's rouge.
2. It is three-dimensional.
3. It will aid in locating the interference in the fit and the problem causing it.
4. By the thickness of the remaining wax the amount of unseating can be evaluated.
5. Helps in evaluating the overall fit of the framework.

Procedure of application:

1. A thin even coat of melted disclosing wax is placed on the entire framework surfaces that will contact the teeth with the help of a roach carver.

2. The framework is placed along the planned path of insertion and gentle finger pressure is applied.
3. If resistance to seating is felt the framework is re-examined for distortion of a clasp arm (especially retentive clasp tips).

Correcting discrepancies:

1. The framework should be removed from the mouth without damaging the surface of the disclosing wax.
2. Evaluate the thickness of wax beneath occlusal rests or indirect retainers.
3. Evaluate the inner surface of the framework, for “high spots,” or areas of metal show-through.

Common areas of metal show through are:

1. Above the survey line on the teeth,
2. Under rests,
3. At the shoulder of circumferential clasps,
4. Under embrasure clasps,
5. In interproximal extensions of lingual plating,
6. Guiding planes.

Correction procedure:

- The located areas of interference are relieved by grinding with a No. 2 round carbide bur in the high-speed handpiece.
- After relieving the areas, the disclosing wax is removed completely by holding the framework over a small flame and the melted wax is blown away with air syringe.
- After the wax is removed fresh wax is added.
- The entire procedure should be repeated until the framework is seated and when the disclosing wax is displaced evenly.
- The time required to seat a framework clinically is approximately 15 to 20 minutes.
- The framework should seat with is a sliding action ones the perfect fit is achieved.
- If gross errors are present repeating the entire framework is better.

Fitting frame work to opposing occlusion

Correction of interferences:

1. Correction should be carried out outside the mouth.
2. Heatless stones or diamond instruments in the high-speed handpiece are used.

Correcting interferences in centric occlusion:

1. After the framework has been fitted to the teeth, it must be adjusted to the opposing occlusion.
2. During correction of occlusal discrepancies the vertical relationship of the jaws should not alter.
3. If both upper and lower frame works are present, the correction should be done one at a time.
4. Observe the patients maxillary and mandibular natural tooth relationship in centric occlusion.
5. After placing both the framework in the patient's mouth, the relationship of tooth in centric occlusion should be the same as without framework placement.
6. One framework is positioned in the mouth, with the patient occluding in centric occlusion. The amount of occlusal interference is evaluated by observing the amount of space between the natural teeth.
7. Articulating paper is placed over the teeth on one side of the arch and the patient is asked to tap the teeth together with light vertical force.
8. All interferences are corrected.
9. The same procedure is repeated with the articulating paper on the opposite side of the arch.

Correcting interferences in eccentric positions:

1. After the centric occlusion corrections are carried out, the patient is guided in both lateral and protrusive positions.
2. Articulating paper is used to locate interferences in each of these positions.

3. The eccentric interferences are corrected the same way as in centric occlusion.
4. Each framework is corrected separately and later checked in the mouth together.
5. After correcting all interferences, a final evaluation is made using articulating paper.

WHAT ARE THE FACTORS INFLUENCING MAGNITUDE OF STRESSES TRANSMITTED TO THE ABUTMENT TEETH?

Factors influencing magnitude of stresses transmitted to abutment teeth

1. Length of edentulous span.
2. Quality of ridge support.
3. Qualities of clasp.
4. Clasp design.
5. Length of clasp.
6. Material used in clasp construction.
7. Abutment tooth surface.
8. Occlusal harmony.

Length of span

A longer edentulous span transfers greater force to the abutment teeth. This happens because the denture base tends to displace the underlying mucosa and moves the partial denture in different positions. This constant movement during function results in larger forces being transmitted to the abutment tooth.

All distal extension denture bases have large edentulous spans depending on the number of missing tooth. The fulcrum line in distal extension partial dentures pass through the posterior most abutment tooth present. If the span of the distal extension denture base is longer from the fulcrum line then more force is exerted on the abutment tooth.

Distribution of force depends on:

1. Load applied to the artificial teeth,

2. Length of the lever arm,
3. Coverage of denture base,
4. Thickness of the mucosa over the ridge,
5. Type of direct retainer used depending on the retentive undercut,
6. Type of artificial tooth used (Eg. the buccolingual width of tooth etc).

If the posterior abutment tooth can be preserved as vertical support or as an overdenture partial denture abutment then force distribution can be efficiently controlled than when only the canines or first premolars are left as the posterior most abutment teeth.

Quality of ridge support

Large, well-formed ridges absorb greater amounts of stress than knife-edged ridges or shallow ridges.

Ideal ridge form:

1. Broad ridges with parallel sides and mucoperiosteum with 1 mm thickness can withstand greater functional loads.
2. Broad ridges permit maximum coverage of denture base, hence stabilizing the denture against lateral forces.

Ideal mucosa:

- Mucoperiosteum, which is firm with 1 mm thickness, can transfer the forces to the ridge.
- Thin atrophic mucosa or soft, flabby, displaceable tissue offers less vertical support and lateral stability to the prosthesis.
- The flabby tissue causes excessive movement of the denture, resulting in transmission of stress to the abutment tooth.

Qualities of clasp

- Flexible clasp arm transmits less force to the abutment tooth.
- In distal extension partial denture a combination or wrought wire retentive clasp is the ideal direct retainer (Class I or II partial dentures).

Disadvantages of combination clasp:

1. Less resistance to horizontal stresses.
2. Increased flexibility can result in both lateral and vertical stresses to be transmitted to the residual ridge instead of abutment tooth.

Clasp design

Factors influencing choice of flexible clasp:

1. Whether the ridge or the abutment tooth requires the most protection.
2. The periodontal support of the abutment tooth.
3. If the periodontal condition is good a less flexible clasp such as a vertical projection clasp can be used.
4. If the periodontal support is weak a more flexible clasp such as the combination clasp with a wrought wire retentive arm can be used so that the residual ridge can share the horizontal forces acting on the partial denture.

Factors influencing clasp design:

1. A passive clasp transmits less stress to the abutment tooth.
2. Clasp should be accurately placed on the abutment tooth for each of its components to function properly.
3. The framework has to be fitted using a disclosing wax and should seat perfectly for the clasp to be passive.
4. The retentive tip should lie in a 0.010 inch undercut.
5. The reciprocal arm should contact the tooth before the retentive tip passes over the greatest bulge of the abutment tooth.

Length of clasp

1. The more flexible the clasp, the less stress to the abutment tooth.
2. Flexibility can be increased by lengthening the clasp.
3. Doubling the length of a clasp will increase its flexibility five times.
4. Clasp length can be increased by using a curved course on an abutment tooth.

Material used in clasp construction

- Chrome alloy clasps are less flexible than other clasp materials thereby greater stress is transmitted to the abutment tooth.
- To compensate for this property, clasp arms of chrome alloys are constructed with a smaller diameter.

Abutment tooth surface

- A restoration on the abutment tooth offers more frictional resistance to clasp arm movement than does the enamel surface of a tooth.
- Greater stress is exerted on a restored tooth than on natural tooth.

Occlusal harmony

1. An improper occlusion generates horizontal forces destructive to both the abutment teeth and residual ridges.
2. Partial denture opposing natural dentition exerts a greater force than one opposing a complete denture.
3. The coverage of denture base also influences the amount of stress transmitted.
4. If more load from occlusion is applied at the distal end of the denture base more stress is transmitted to the abutment tooth.
5. The second premolar and first molar are the best areas for the application of masticating load.
6. Artificial teeth should be arranged so that masticating force is applied in that area.

Controlling stress on abutments by design considerations*1. Direct retention*

Clasp retention should be placed to a minimum, yet provide adequate retention to prevent dislodgement.

2. Forces of adhesion and cohesion

Maximum denture base coverage enhances the adhesion and cohesion to increase retention.

Adhesion is the attraction of saliva to the denture and the tissues and cohesion is the internal attraction of the molecules of saliva for each other.

Atmospheric pressure contributes a slight amount of retention especially in maxillary complete palate major connector.

3. *Frictional control*

Guide planes are created so that they are parallel to each other and parallel to the path of denture insertion. The frictional contact of the prosthesis against these parallel surfaces increases the retention of the denture.

4. *Neuromuscular control*

If the patient is able to control the action of the lips, cheeks and tongue with the denture, retention of a denture is improved.

A properly contoured denture base aids the patient's neuromuscular control of the prosthesis.

5. *Clasp position*

Position of the retentive clasp to the height of contour is more important in retention and in controlling stress than is the number of clasps.

1. Quadrilateral configuration: Indicated for Class III arches with modification space on the opposite side of the arch.

A retentive clasp is positioned on each abutment tooth adjacent to the edentulous spaces, hence giving a quadrilateral configuration.

2. Tripod configuration: For Class II arches with a modification space on the edentulous side. The teeth anterior and posterior to the space are clasped to form a tripod configuration.
3. Bilateral configuration: Class I situation. Retentive clasp on each side of the arch on the posterior most abutments.

6. *Type of clasp*

1. Circumferential cast clasp: Originates from a distal occlusal rest on the terminal abutment tooth and engages a mesiobuccal retentive undercut.

Not be used on a distal extension removable partial denture.

2. Bar clasp: Can be used on the terminal abutment tooth on a distal extension partial denture when the retentive undercut is on the distobuccal surface. It is never indicated when the tooth has a mesiobuccal undercut.

3. Combination clasp: When a mesiobuccal undercut exists on an abutment tooth adjacent to a distal extension edentulous ridge and in distal extension bases.

7. *Splinting of abutment teeth*

Adjacent teeth may be splinted by means of crowns to control stress transmitted to a weak abutment tooth.

Splinting can be achieved by crowns, multiple clasps, lingual plating, swing-lock partial denture and cross arch stabilisation with major connectors.

Splinting is also indicated when the abutment tooth has a tapered root or short roots.

8. *Indirect retention*

An indirect retainer is a part of the removable partial denture that prevents the direct retainer from displacement of the distal extension denture by resisting the rotational movement of the denture around the fulcrum line, established by the occlusal rests.

9. *Occlusion*

An occlusion that is in harmony with the movements of both the temporomandibular joints and the neuromusculature will reduce the stress transferred to the abutment teeth and residual ridge.

Occlusion must be coordinated with mandibular movements and the guiding influence of the remaining natural teeth. The occlusal contacts of the remaining natural teeth should be the same after the placement of removable partial denture in the mouth.

10. *Artificial teeth*

Food table of the artificial teeth should be narrow in buccolingual width.

The number of teeth being replaced can also be reduced to decrease the stress.

Artificial posterior teeth should possess sharp cutting surfaces.

Artificial teeth should not have steep cuspal inclines.

11. *Maximum coverage of denture base*

The distal extension denture bases of mandibular should extend onto the retromolar pad area.

The distal extension denture bases of maxillary should cover the entire tuberosity.

Adaptation of the denture base to the residual ridge should be perfect.

A dual impression of distal extension gives accurate precision.

12. *Major connector*

Lingual plate major connector with properly supported rests aid in the distribution of functional stresses to the remaining teeth.

A complete palatal major connector of maxillary distributes forces better than other major connector designs.

13. *Minor connector*

Help all the partial denture components to function efficiently.

DISCUSS THE HARMFUL EFFECTS OF A WRONGLY DESIGNED RPD ON A PATIENT OF 40 YEARS

Causes of damage related to the wearing of wrongly designed partial dentures

1. Plaque accumulation around partial denture.
2. Direct trauma from components of the denture, from excessive functional forces.
3. Denture-induced hyperplasia due to the transmission of excessive functional forces.

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4. Occlusal error dysfunction.
5. Aggravation of existing periodontal disease.

Plaque accumulation

Causes decalcification and caries.

If plaque persists, it can lead to chronic periodontitis with the periodontal attachment destroyed, periodontal pocket and alveolar bone loss.

If plaque collects between the denture and the denture-bearing mucosa, denture stomatitis can occur.

Direct trauma from components

Examples of components that can cause trauma to tissues:

- The major connectors placed close to gingival margins,
- An active clasp arm,
- An occlusal rest that doesn't seat and
- Minimum coverage of denture base.

Symptoms

1. Mobility of tooth.
2. Wear of tooth.
3. Periodontal changes.
4. Excessive bone resorption.

Occlusal error dysfunction

1. If the premature contact is on a natural tooth.
2. If the saddle is overloaded, mucosal inflammation and resorption of the underlying bone occurs.
3. Abnormal closing pattern as a result of faulty occlusion.

Ill-fitting prosthesis can be due to

1. *Improper treatment planning:*

The complete oral examination must include both clinical and radiographic evaluation of caries, condition of existing restorations, periodontal conditions, vitality of remaining teeth and existing occlusal relationship.

2. *Wrong designing:*

Failure to identify the tooth supported and tissue supported design principles as

- a. Prosthesis support.
- b. Impression methods required.
- c. Types of direct retainers best suited for each.
- d. Denture base material suited for each.
- e. Need for indirect retention.

3. *Eliminating the use of surveyor:*

It is difficult to plan mouth preparations without surveying. Mouth preparations enhance the longevity of the prosthesis providing better support, stabilization, retention and a harmonious occlusion for the partial denture.

4. *Eliminating guide planes when needed.*

5. *Improper preparation of occlusal rest seats*, wrong placement and lack of clearance for occlusal rest seat can result in failure of partial denture.

6. *Retentive areas must be identified correctly*, placement of direct retainers in correct position, selecting the right direct retainer, selection of the material and amount of flexibility required for direct retainer are all important factors in the success of partial denture.

7. *If block out procedures are not carried out when required* can also distort the framework.

8. *Precision in laboratory procedures is a must* in partial denture which otherwise can lead to failure in the partial denture design.

9. *Checking the fit of framework procedure should be carried out accurately* or the framework can cause destruction to the underlying bone.

Support for distal extension denture bases

If inadequate support is given due to wrong designing the partial denture tends to fail. A dual impression procedure needs to be done for the success of distal extension bases.

Reasons for failure of clasp-retained partial dentures

1. Inadequate mouth preparation and wrong planning of the design.
2. Impression procedures carried out without normal tissue health.
3. Incorrect use of clasp designs.
4. Material of choice for clasps. (Cast clasps are rigid and if used in distal extension case can result in failure of partial denture).
5. Material of choice for denture.

Materials that can be used:

- Acrylic resin.
- Gold alloys.
- Base metal alloys.

Factors to be ensured for successful clasp design

1. Retentive undercuts:
Gold alloy: undercut usually 0.75 mm
Cobalt-chromium: undercut usually 0.25 mm.
Undercuts greater than 0.25 mm, wrought wire clasp is to be used.
2. The retentive arm should be at some distance from the body or point of attachment.
3. Usage of gingivally approaching clasps when needed as less lateral load to the abutment tooth.
4. Do not adjust cobalt-chromium cast clasps.
5. Clasps should taper more towards their tips as for the clasp arm to displace into a severe undercut when forces are applied.
6. Clasps must be accurately positioned and accurately cast.
7. Do not use rigid clasping system when distal extension partial dentures exist.

A successful partial denture will function and be comfortable to the patient.

Care should be taken from diagnosis and treatment planning to the final insertion of a partial denture.

For longevity of partial dentures good oral hygiene measures, as well as fluoride therapy for abutment teeth has to be ensured.

Recall visits aid the dentist to check the fitness, function and oral hygiene of the patient.

Proper instructions and home care regime is a must.

DESPITE SHORTCOMINGS, ALGINATE IMPRESSION MATERIAL ENJOYS POPULARITY AMONG DENTISTS. DISCUSS. ADD A NOTE ON ITS SHORTCOMINGS AND ADVANTAGES.

Alginate is the most widely used impression material and is also the most versatile impression material. Its popularity is due to its various advantages.

Advantages

1. Easy handling.
2. Inexpensive yet reasonably accurate compared to other elastic impression materials.
3. No additional items or equipments required.
4. Cleanliness of the material.
5. Can use different types depending on the need for fast setting or normal setting.
6. Custom made tray is not required.
7. Need no application of adhesive when perforated trays are used.
8. Best for single impressions in partial dentures.
9. In dual impression the functional impression can be picked up using alginate impression in a stock tray.
10. Modified alginates have better surface reproduction.
11. Colour coded alginates help in identifying the time required to complete an impression.
12. Dust free alginates containing glycerine helps to prevent allergies.
13. Disinfected alginates are also available.

All the above factors still favour alginate to be used as a material of choice in all type of impressions.

Problems encountered with alginate impression making

1. Alginate sticking to teeth.
2. Voids in impression.
3. Peripheral underextension.
4. Alginate tears while removing impression.
5. Grainy appearance.
6. Alginate sets before impression is completed.
7. Gag reflex while making impression.
8. Alginate washed by saliva in palate.
9. Alginate pulled away from the tray.

Problems encountered while pouring cast

1. Cast has rough surface.
2. Cast has chalky appearance.
3. Cast has soft appearance.
4. Breakage of cast.
5. Separation of cast between first and second pours of stone.
6. Voids in the cast.
7. Underextension of cast.
8. Inaccurate cast.

Problems encountered with alginate impression making

Alginate sticking to teeth

Reasons:

- a. Vigorous pumicing of teeth.
Avoid impression making immediately after polishing tooth with pumice or silicone as protective coating for teeth.
- b. Excessively dry tooth.
Before impression making for a dry field isolating the area with gauze packs can avoid over drying of tooth.
- c. Repeated impressions can wash away the protective coating of tooth.
Use silicone as protective film before impression making.

Voids in impression

Reasons:

- a. Improper mix of alginate.
Spatulation should be within 45 to 60 seconds by hand or 15 seconds mechanically under vacuum.
- b. A thick mix, loading the tray with less material or improper tray placement can cause deficiency of material in certain areas. The commonest defects occur in palate, vestibular areas and lingual aspect in mandibular.
Avoid mix that is too thick or thin.
Use correct water/powder ratio, measure alginate by weight, avoid using old packets of alginate that was exposed by heat or moisture contamination.

Peripheral underextension

Reasons:

1. Improper mix:
Less material loaded on to the tray.
2. Improper selection of tray:
Use tray with 5 to 7mm clearance.
3. Incorrect tray placement:
Centre tray with handle corresponding to mid line of face, seat tray below gingival marginal areas, select the correct tray size, which will not interfere with coronoid processes of mandible.
4. Cheeks, lips, or floor of mouth trapped under tray.
Check for entrapment by asking the patient to protrude the tongue.

Tearing of alginate while removing impression from patient's mouth

Reasons:

- a. Improper mix of alginate;
Use correct water/powder.
Measure alginate by weight.
- b. Impression removed before setting time is completed:

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Impression should be placed in the mouth 2 to 3 minutes after it loses its tackiness.

- c. Less amount of alginate:
Select proper tray with good clearance.
Centre tray properly.
- d. Use of deteriorated alginate:
Store alginate in airtight containers at room temperature.
- e. Prolonged or insufficient spatulation:
Spatulation time 45 to 60 seconds.
- f. Improper removal from mouth:
Should be removed with a snap along long axis of tooth

Grainy appearance

Reasons:

- a. Prolonged or insufficient spatulation.
- b. Insufficient flow of material.
- c. Improper mixing:
Use correct water/powder ratio
Measure by weight.
- d. Impression removed before setting time is complete.

Early setting of alginate

Reasons:

- a. When warm water is used to mix alginate it sets fast (Ideal temperature is 22°C)
- b. Contaminated mixing bowl with particles of dental stone.
(Use different mixing bowls for alginate.).
- c. Prolonged spatulation of alginate.
- d. Use of deteriorated alginate.
- e. Fast-set alginate. Regular-set alginate has normal setting time.

Patient gags while impression is made

Distract patient's attention to other topics.

Reasons:

- a. Psychological.
- b. Too thin a mix.

- c. Excessive material loaded on to the tray, which can flow into patient's throat.
- d. Improper seating of patient.
- e. Over extended tray.
- f. Excessive pressure while making impression.

To prevent gagging:

- a. Instruct patient to keep eyes open and breathe through the nose at normal rate.
- b. Use of topical anaesthetics or cold water rinses.
- c. Leg lift procedure; along with use of fast-set alginate.

Alginate washed away by saliva in palate

Reasons:

- a. When mucous saliva is not removed from palate before impression making:
Use astringent mouth rinse and cold water rinse.
Wipe and isolate palate with gauze.
- b. Excessive palatal secretion:
Use warm gauze to increase secretion followed by cold pads to constrict gland openings.
- c. Copious amounts of saliva:
Premedicate with 15 mg of propantheline bromide 30 minutes before procedure.

Alginate pulled away from the tray

- a. Use rim lock perforated trays
- b. Can use alginate adhesives to enhance retention of alginate to tray.

Problems in relation to pouring of cast

Cast has rough surface

Reasons:

- a. Incompatibility between alginate and dental stone.
- b. Insufficient spatulation of stone.
- c. Saliva retained on impression.

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- d. Water left on impression.
- e. Improper mix of alginate.

Chalky appearance of cast

Reasons:

- a. Incompatible alginate/stone combination.
- b. Stone slurry left on cast after trimming.
- c. Impression left in contact with cast for prolonged period.

Cast has a soft surface

Reasons:

- a. Watery stone mix – Use correct water powder ratio, measure stone by weight. In case if inverted single-stage pour technique.
- b. Use of contaminated stone.
- c. Prolonged spatulation of dental stone.

Breakage of cast

Reasons:

- a. Premature removal of impression from cast.
- b. Too much water in mix of stone.
- c. Use of single-stage pour technique.
- d. Water left in impression.
- e. Low compressive strength of dental stone.
- f. Alginate impression left in contact with cast overnight.

Separation of cast between first and second pours of stone

Reasons:

- a. Not placing mechanical retention for second pour.
- b. Failure to wet first pour before adding second pour.

Void in surface of cast

Reasons:

- a. Air entrapment while mixing
- b. Cast poured too rapidly.
- c. Overvibration during pouring

Underextension of cast

Reasons:

- a. Cast over trimmed
- b. Dental stone did not flow into all peripheral areas of impression
- c. Underextension of alginate impression
- d. Prolonged setting time of stone
- e. Contamination of stone by heat or moisture

Inaccurate cast

Reasons:

- a. Syneresis or imbibition has altered the impression.
- b. Strains or distortion caused by movement during gelation.
- c. Impression removed before gelation was complete.
- d. Strains induced in impression during its removal from mouth.
- e. Non-rigid impression tray.
- f. Unsupported impression posteriorly.
- g. Washing or soaking cast in tap water caused details to be lost.
- h. When teeth contact tray during making of impression.
- i. Distortion in palate due to incorrect tray selection.

DEFINE IMMEDIATE DENTURE. CLASSIFY IMMEDIATE DENTURES. ADD A NOTE ON THEIR ADVANTAGES AND DISADVANTAGES. ENUMERATE THE CLINICAL STEPS IN RELATION TO IMMEDIATE DENTURES.

Definition

A denture constructed before the extraction of the teeth, which it replaces and fitted immediately after the teeth are extracted.

Types

Interim—Short-term prosthesis until treatment is feasible.

Transitional in cases where the rest of the tooth are not restorable but the patient is not physiologically or psychologically fit for a permanent prosthesis.

Treatment prosthesis contains tissue conditioners or other treatment procedures to bring the tissues to normal condition.

Advantages

1. The edentulous period is eliminated hence great social and psychological significance.
2. A natural and functional relation ship of tooth can be obtained as the lip position, occlusal plane, vertical height and occlusion are not altered from the natural dentition.
3. Facial contour and tone of facial muscles is maintained.
4. No development time for unnatural mandibular movements.
5. Size, shape, shade and position of teeth can be accurately reproduced.
5. Speech is not hampered.
6. No interference with the temporomandibular joint and its function.
7. Function of mastication is maintained.
8. No change in tongue shape.
9. Little interference with diet.
10. Resorption of alveolar bone is less.
11. Healing is quickened.

Disadvantages

1. In cases of deep vertical overlap, extreme rotation, tilting or migration it is difficult to achieve occlusion in the prosthesis.
2. Require relining the denture after some time due to bone remodelling.
3. General health may not permit multiple extractions.
4. Additional expense and time.
5. Only can be made for responsible patients with good oral hygiene.
6. Gross oral sepsis is possible.

Types of immediate denture

- a. Open face design.
- b. Labial flange without alveolectomy.
- c. Labial flange with alveolectomy (Excision).
- d. Labial flange with alveolectomy (Incision).

Open face design

Advantages:

1. Natural appearance.
2. Exact reproduction of tooth position.
3. Easy to insert.
4. Teeth arrangement is easy.
5. No interference with lip musculature.

Disadvantages:

1. Poor retention and inadequate support.
2. Denture has short life.
3. Natural appearance is lost after bone remodelling starts.
4. Difficult to rebase.
6. Irregularities of anterior ridge as spiky alveolus or flabby mucosa can develop.
7. Sockets and gingivae must not be traumatized during surgery.

Labial flange without alveolectomy

Advantages

1. Good retention and support.
2. Ease of rebasing.
3. Rapid healing with smooth ridges.
4. Stronger denture.

Disadvantages

1. Labial fullness.
2. Difficult in case of undercuts.
3. Lack of space around necks of teeth.

Labial flange with alveolectomy (Excision)

Indications

1. Prominent pre-maxilla, which prevents insertion of a flanged denture and osseous defects.
2. Limited anterior interalveolar space and deep vertical overlap.

Contraindication: Increase in resorption following labial cortical bone removal.

Labial flange with alveolotomy (Incision)

A modification of the above where the operation of transeptal alveolectomy or intra septal alveolotomy is carried out which collapses the anterior buccal plate to eliminate the undercut.

Advantages:

1. No cortical bone is removed and post-surgical resorption is reduced.
2. Surgery is less traumatic than alveolectomy.
3. Less interference with facial form.

Disadvantages:

1. The undercut cannot always be completely eliminated.
2. Bone is removed which can cause further resorption.

Post-immediate or delayed immediate dentures

Can replace posterior and anterior teeth at the same time.

In this technique trial dentures are prepared on casts with the teeth been cut off and the ridge is smoothed. After the extraction of teeth, the trial dentures are inserted in the mouth with a zinc oxide-eugenol paste or elastomeric impressions made in closed mouth position.

The dentures are processed and fitted the same day.

Clinical steps in relation to immediate partial denture

- a. Oral hygiene prophylaxis is carried out.
- b. Posterior teeth are extracted, with the exception of first four premolars.

- c. The extraction of the posterior teeth is carried out under local or general anaesthesia in two visits.
During extraction the interdental and interradicular alveolus is smoothed with adequate suturing.
- d. The patient is recalled after six to eight weeks.
- e. Preliminary impressions are made in alginate and stock trays.
- f. Master impressions are made in alginate or elastomer. Or a dual impression technique is made.
- g. Record blocks are prepared and jaw relations are registered in retruded contact position.
- h. A facebow record of the maxillary cast is made.
- i. Shade of teeth is noted.
- j. The posterior teeth are set in balanced occlusion if possible.
- k. The partial wax dentures are tried in the mouth, the occlusion verified and the anterior teeth checked for shade, shape and form.
- l. Laboratory procedures for placement of teeth:
 - Removing the plaster teeth and carving the cast after the partial wax dentures have been checked in the mouth.
 - The alternate teeth are removed one at a time and the acrylic tooth set in position.
 - The altering of cast to place tooth differs in each type:

Open face design The plaster tooth is removed at the level of the gingival margin; the socket and the labial margins are deepened 1-2 mm leaving the margins intact.

Labial flange without alveolectomy Sockets are not carved only the labial part of the gingival margin is scraped to allow for collapse of the soft gingival border after extraction.

Labial flange with alveolectomy Sockets are carved a little deeper and the labial plate is reduced by scraping in the area of the attached mucosa. Interdental areas

are reduced and the ridge is scraped to form a smooth rounded labial contour. No lingual or palatal scraping is done.

A duplicate cast is made with a clear acrylic base-plate that can act as a guide to the removal of bone.

The dentures are processed, remounted and then finished in the laboratory.

- m. The patient is recalled for the extraction of the remaining anterior teeth.

The finished denture is delivered with minimal adjustment.

- n. After three to five days the occlusion is checked and perfected by selective grinding.
- o. The patient is recalled in two to three months and rebase of the dentures are done if required or replacement of dentures can be done.

SHORT NOTES

DIAGNOSTIC CASTS

- A diagnostic cast should be an accurate reproduction of the teeth and adjacent tissues, poured in dental stone, because of its strength and abrasion resistance.
- The impression for the diagnostic cast is made with irreversible hydrocolloid (alginate) in a perforated impression tray.
- It is a life size reproduction of a part or parts of the oral cavity or facial structures for the purpose of study and treatment planning.

Importance of diagnostic casts

1. Diagnostic casts permit viewing of the occlusion from the lingual and buccal aspect.
2. To analyse the existing occlusion in case of needed occlusal adjustment and occlusal reconstruction.
3. Aids in diagnostic wax up, to determine the occlusion before definitive treatment is begun.
4. Diagnostic casts helps to survey the dental arch as a whole.
5. Helps in surveying of the cast to determine existing soft tissue under cuts, parallelism of teeth as for over denture cases.
6. Aids in mouth preparation decisions, as to the removal of soft tissue undercuts.
7. Helps to show and discuss the case with patient regarding the treatment plans, needed corrections and problems if any.
8. Aids to select and fabricate trays.
9. If needed can duplicate diagnostic cast in case a undercut has to be blocked.
10. Diagnostic casts may be used as a constant reference.
11. In areas where alterations are required as in soft tissue or hard tissues, a rough alteration can be mocked on the duplicate cast to assess the out come.

Parts of a cast

- Base portion
- Anatomic portion: includes the teeth and soft tissue areas

Sides of a diagnostic cast

1. Anterior cut
2. Side cut
3. Corner cut
4. Heel cut.

Maxillary diagnostic cast

- The base is cut parallel to the occlusal plane.
- The heel is cut at the base and should be perpendicular to the median raphe and 0.6 cm distal to the deeper pterygomaxillary notch area.
- The side cut is made 63 degrees to the heel cut
- The anterior cut is made from midline to canine eminence region. The same procedure is repeated on the opposite side.

Mandibular diagnostic cast

- The base is made parallel to the occlusal plane.
- The heel cut is made to flush with the maxillary heel cut.
- The side cut is made from the heel cut at 55 degrees.
- The anterior cut is rounded from one canine region to the opposite side.

INDICATIONS AND REQUIREMENTS OF REMOVABLE PARTIAL DENTURES

Indications

1. When fixed restoration is contraindicated.
2. In distal extension situations. (Kennedy Class I and Class II).
3. After recent extractions.
4. When relining due to bone modelling is required (temporary removable partial denture can be given).

5. When patient cannot afford a fixed restoration.
6. Long span situations. A long span may be totally tooth supported if the abutments and the means of transferring the support to the denture are adequate and if the denture framework is rigid.
7. When periodontal support of abutment tooth is very weak.
8. Patient unwilling for the preparation of abutment tooth.
9. In patient prone for excessive loss of residual bone, bilateral stabilization can be achieved by partial denture.
10. When abutment tooth is not ideal for fixed restorations as in
 - a. Tapered root
 - b. Inadequate crown root ratio
 - c. Bone resorption around the abutment tooth.
11. In cases with large osseous defects in which the fixed restoration will not be esthetic (loss of residual bone from the labial aspect).
12. In case of large spacing between tooth.
13. In excessively resorbed ridges.
14. Caries prone mouth.
 - Design can be altered if sudden loss of abutment teeth.
 - Later additions can be made on removable partial dentures but cannot be done on fixed restorations.
 - Can retain slightly mobile abutment tooth in case of removable prosthesis but cannot retain questionable abutments in case of fixed restorations.
 - Splinting effect can be attained with removable restoration, thereby reversing the periodontal changes in some situations.
15. Can aid as a treatment prosthesis if tissues are distorted or if any surgical procedures have being carried out.
16. Ideal for cleft palate cases requiring replacement of teeth.
17. In older patients needing replacement of tooth.
 - In very young patients the abutment will have large pulp chambers, which can get exposed during preparation of tooth.

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- Such patients removable partial denture can be given for short term after which definitive fixed restoration can be given.
- 18. To prevent space closure in early loss of teeth.
- 19. As a temporary prosthesis in accident cases with loss of teeth requiring other surgical procedures.
- 20. In systemic diseases in which loss of tooth is invariable.

Requirements of partial denture

1. It must distribute forces evenly over the supporting tissues within their physiological limit.
2. It must be retained in position during all normal functional movements.
3. It must prevent teeth from drifting or tilting into edentulous spaces.
4. It must preserve soft and hard tissues.
5. It must restore function and preventing over-eruption of the opposing tooth.
6. It must restore masticatory efficiency and appearance.
7. It must be comfortable for the patient to wear.

APPLEGATE'S RULES

Applegate's rules for applying the Kennedy classification

Applegate provided the following eight rules for the easy application of the Kennedy method:

- Rule 1. Classification should follow rather than precede any extractions of teeth that might alter the original classification.
- Rule 2. If a third molar is missing and not to be replaced, it is not considered in the classification.
- Rule 3. If a third molar is present and is to be used as an abutment, it is considered in the classification.
- Rule 4. If a second molar is missing and is not to be replaced, it is not considered in the classification

(for example, if the opposing second molar is likewise missing and is not to be replaced).

- Rule 5. The most posterior edentulous area or areas always determines the classification.
- Rule 6. Edentulous areas other than those determining the classification are referred to as modifications and are designated by their number.
- Rule 7. The extent of the modification is not considered, only the number of additional edentulous areas.
- Rule 8. There can be no modification areas in Class IV arches. (Another edentulous area lying posterior to the “single bilateral area crossing the midline” would determine the classification.)

PRINCIPLES OF RPD DESIGNING

Factors influencing design

1. A choice between FPD and RPD is made depending on the number of teeth missing, periodontal situation and patient's choice.
If RPD is the line of treatment planned, then the:
 - a. Occlusal relationship of remaining teeth,
 - b. Orientation of the occlusal plane,
 - c. Space available for restoration of missing teeth,
 - d. Arch integrity is evaluated.
2. Need for abutment restorations.
3. Response of oral structures to previous stress, periodontal condition of the remaining teeth, the amount of abutment support remaining and the need for splinting, etc. should be evaluated.
4. Type of major connector to be used.
5. Whether the denture is tooth supported, tissue supported or tooth tissue supported. If it is a distal extension denture then the following has to be assessed:
 - a. Need for indirect retention

- b. Clasp designs that will best minimize the forces applied to the abutment teeth during function
 - c. Type of base material used
 - d. Secondary impression method to be used
6. Materials to be used, both for the framework and for the bases.

Diagnosis and treatment planning

Proper diagnosis and treatment planning includes abutment tooth evaluation and edentulous ridge evaluation.

Abutment tooth evaluation:

1. Periodontal health.
2. Crown and root morphologies and ratio.
3. Bone index area.
4. Location of the tooth in the arch.
5. Relationship of the tooth to other support units and
6. The opposing dentition.

Edentulous ridge area evaluation:

1. The quality of the residual ridge
2. Denture base coverage.
3. Type and accuracy of the impression registration
4. Fit of denture base
5. The design of partial denture framework and
6. The occlusal load.

Ideal impression technique

Any Physiologic impression technique or selective pressure technique.

Important factors in the impression for distal extension partial dentures:

1. The material should record the tissues covering the primary stress-bearing areas in their supporting form
2. Tissues within the basal seat area other than primary stress-bearing areas must be recorded in their anatomic form and

3. The total area covered by the impression should be maximum, for uniform load distribution.

Essentials of partial denture design

1. Locating rest seat on principal abutment tooth. (Support areas)
2. Connecting the tooth and tissue support units by designing and locating major and minor connectors.
3. Designing direct and indirect retainers to:
 - a. Avoid direct transmission of tipping or torquing forces to the abutment.
 - b. To correctly position clasp assembly in definitive location on abutment tooth surfaces.
 - c. To provide retention against dislodging forces and be compatible with undercut location, tissue contour and esthetic desires of the patient.
4. Connecting the retention units to the support units.
5. Designing outline and joining the edentulous area to the already established design components.

Components of partial denture design

1. Major connector
2. Minor connector
3. Rests
4. Direct retainers
5. Reciprocal or stabilizing components (as parts of a direct retainer assembly)
6. Indirect retainers (if the prosthesis has one or more distal extension bases)
7. One or more bases, each supporting one to several replacement teeth.

Direct retention

Objectives of direct retention:

1. Restoration of function and appearance.
2. Preservation of the health and

3. Integrity of all the oral structures that remain.
4. Aid in close adaptation and fit of denture base against multiple, properly prepared guide planes.

Design aspect

The most posterior teeth on each side of arch should be clasped:

1. For distobuccal retention use I-bar.
2. For mesiobuccal retention use 18 gauge wrought wire clasp or simple circumferential clasp.

Depending on the amount of undercut

1. Cast cobalt-chromium clasps for 0.010 inch of retentive undercut. (Not ideal for use on mesiobuccal undercut on the posterior abutment tooth.)
2. Wrought wire clasps for 0.020 inches of retentive undercut.
3. In case of excessive bone loss double clasping can be designed.

Ideal design of direct retainers

1. A Class I prosthesis requires only two retentive clasp arms one on each terminal tooth.
 - a. If a distobuccal undercut is present, the vertical projection clasp is preferred.
 - b. If a mesiobuccal undercut is present, a wrought wire clasp is indicated (A cast circumferential type clasp should not be used).
 - c. The reciprocal or bracing arm must be rigid.

Stabilizing components

Are those rigid components that assist in stabilizing the denture against horizontal movement, hence distributing stresses equally to all supporting teeth without overworking any one tooth. The minor connectors that join the rests and the clasp assemblies to the major connector serve as stabilizing components.

Guiding planes

The functions of guiding plane surfaces are as follows:

1. To provide for one path of placement and removal of the restoration.
2. To provide retention against dislodgement of the restoration when the dislodging force is directed other than parallel to the path of removal and also to provide stabilization against horizontal rotation of the denture.
3. To eliminate food accumulation between abutment teeth and components of the denture.

Indirect retainers

- An indirect retainer must be placed as far anteriorly from the fulcrum line as adequate tooth support permits.
- Either a canine or premolar tooth should be used for the support of an indirect retainer.
- An incisal rest or a lingual rest may be used on an anterior tooth, provided a definite seat can be obtained either in sound enamel or on a cast restoration.

ADVANTAGES AND DISADVANTAGES OF KENNEDY'S CLASSIFICATION

Requirements of an acceptable method of classification

1. It should permit immediate visualization of the type of partially edentulous arch being considered.
2. It should permit immediate differentiation between the tooth-borne and tooth- tissue supported removable partial denture.
3. It should be universally acceptable.

A world wide accepted classification is that devised by Edward Kennedy in 1923.

It gives a clear understanding about the type of denture under consideration.

The Kennedy classification is based on the relationship of the edentulous areas to the natural teeth.

Kennedy's classification

Kennedy's classification has four main groups with modifications except for Class IV.

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Class I: Bilateral free-end edentulous areas posterior to the natural teeth.

Class II: Unilateral free-end edentulous area posterior to the natural teeth.

Class III: A bounded unilateral edentulous area having natural teeth at each end.

Class IV: A bounded edentulous area anterior to the natural teeth.

Modifications: All classes, except Class IV, have modifications. Each modification is an additional edentulous area.

Criteria for the Kennedy classification:

1. The most posterior edentulous area determines the class.
2. The size of the modification is not important.
3. If a third molar is missing and not to be replaced, it is not considered in determining the class.

Advantages of Kennedy's classification

1. Allows visualization of partially edentulous arch.
2. Differentiates between tooth supported and tooth tissue supported.
3. Type of design can be decided upon.
4. It is universally accepted.
5. Aids in discussing, identifying and planning the design.
6. Easy to apply the system to any situation.
7. Widely used system.
8. Forms the basis for two other systems as Applegate Kennedy and Swenson's system.

Disadvantages

1. Kennedy's classification is a positional or anatomic classification which conveys a tooth/saddle relationship, but gives little information of teeth present and their positions.
2. Without Applegate's modifications Kennedy's classification could have been meaningless.

3. Critics argue that grouping of Kennedy's classification should have been reversed (Class II situation should have been grouped as Class I)
4. It is based on incidence of clinical situation requiring removable prosthesis. (Class I is the most frequent situation.)
5. As the number of teeth missing is not specified, support cannot be analysed.

ABUTMENT SELECTION

Oral examination of abutment tooth includes

1. Carious lesions and defective restorations.
2. Testing for pulp vitality.
3. Test for sensitivity to percussion.
4. Mobility.
5. Pocket depth, inflammation, and amount of attached gingiva of the abutment teeth.

Other diagnostic aids required are:

1. Radiographs of the abutment teeth and the residual ridge areas.
2. Mounted casts to evaluate the presence of extruded teeth, malposed teeth, reduced interarch space and unfavourable occlusal plane.

Evaluation of caries and existing restorations

All caries lesions need to be restored with intracoronal restoration.

Extruded tooth above the occlusal plane need to be restored with an extra coronal restoration to improve the occlusal plane.

If rest seat needs to be prepared, a cast metallic restoration is preferred as restoration.

Evaluation of pulp

An electric pulp tester and thermal tests are used to detect pulpal necrosis or pulpitis.

Endodontically treated tooth, if used as an abutment, should be evaluated for the success of endodontic treatment.

Evaluation of sensitivity to percussion

Sensitivity can be due to:

1. Tooth movement caused by a prosthesis or the occlusion.
2. A tooth or restoration in traumatic occlusion.
3. Periapical or pulpal abscess.
4. Acute pulpitis.
5. Gingivitis or periodontitis.
6. Cracked tooth syndrome.

Evaluation of mobile teeth

A mobile tooth used as an abutment tooth will have a poor prognosis unless mobility is eliminated.

Causes of mobility:

1. Trauma from occlusion (reversible).
2. Inflammatory changes in the periodontal ligament (reversible).
3. Loss of alveolar bone support (not reversible).

Splinting of abutment teeth to decrease mobility:

1. The combined splinted teeth with crowns should provide an abutment with greater total periodontal support.
2. The crowns of splinted teeth should be in harmony with the occlusion of the remaining teeth.
3. The removable partial denture constructed should place minimum stress on the splinted teeth.
4. Splinting can be done if two or three retainable teeth are widely placed.

Evaluation of periodontium

Findings requiring periodontal treatment are:

1. Pocket depth in excess of 1mm with furcation involvement
2. Gingivitis
3. Marginal exudate

4. Less than 2 mm of attached gingiva.
5. High frenal attachment.

Not good abutments:

1. Excessive pocket depth
2. Furcation involvement
3. Osseous bone loss
4. Tapered root with less crown root ratio.
5. Mobility.

Evaluation of radiographic survey

Abutment tooth evaluation:

1. Root Length, Size and Form

Teeth with large or long roots are more favourable for abutment teeth. Multi-rooted teeth whose roots are divergent or curved are stronger abutment teeth than single-rooted teeth.

2. Crown/Root ratio:

A crown/root ratio of at least 1:1 is required for an abutment tooth.

3. Lamina dura:

Should be checked for absence, discontinuity, partial loss or thickening of lamina dura.

Total absence of the lamina dura may be due to systemic disorders such as hyperparathyroidism and Paget's disease. A thickening of the lamina dura can be due to trauma from occlusion.

4. Periodontal ligament space:

A widening of the periodontal ligament space with a thickening of the lamina dura indicates occlusal trauma and heavy function. Clinical mobility of the tooth may also be present with the above findings.

5. Bone index areas:

Bone index areas are areas of alveolar bone that support teeth known to have been subjected to a larger than normal workload. If there is a positive response of the alveolar bone and the periodontal ligament to the

increased forces, the patient has “a positive bone factor”. Signs of a positive response include a supportive trabecular pattern, heavy cortical layer, dense lamina dura, normal bone height and a normal periodontal ligament space.

Evaluation of mounted diagnostic casts

- Insufficient interarch distance,
 - Irregular occlusal plane,
 - Occlusion,
 - Extruded or malposed teeth.
1. Interarch distance: A decrease in interarch distance occurs when teeth unopposed by occlusion tend to over erupt over a period of time carrying the alveolar process with it. Surgical correction can be done.
 2. Occlusal plane: The occlusal plane may be irregular due to extrusion of one or more unopposed teeth or due to malposed tooth. Corrective procedures as enameloplasty or extra coronal cast metallic restoration are done to develop an acceptable occlusion.
 3. Occlusion: A discrepancy between centric jaw relation and maximum occlusal contact, or centric occlusion should be evaluated.
 4. Tipped or malposed teeth: Limited orthodontic procedures can be used to upright the tipped tooth.

PERIODONTAL ASPECTS IN MOUTH PREPARATION

Periodontal preparation generally follows surgical procedures and before restorative procedures begin.

Objectives of periodontal therapy

To return health of the supporting structures of the teeth.

1. Removing all etiologic factors causing periodontal disease.
2. Eliminating all pockets and maintaining gingival sulci free of inflammation.

3. Creating physiologic gingival and osseous architecture.
4. Establishing functional occlusal relationships.
5. Maintaining good oral hygiene.

Diagnosis of periodontal diseases

Health history of the patient along with oral examination:

Use direct vision, palpation, periodontal probe, mouth mirror and other auxiliary aids such as curved explorers, furcation probes, diagnostic casts and roentgenograms.

Gingival sulcus pocket depth measurement: The probe is inserted gently but firmly between the gingival margin and the tooth surface and the depth of the sulcus is determined around each tooth.

Pocket depths are recorded for the distobuccal, mesial, mesiobuccal, distolingual, lingual and mesiolingual aspects of each tooth.

Other factors to be checked:

- a. Check bleeding on probing for sulcular health.
- b. Evaluate the extent and pattern of bone loss.
- c. Assess the degree of mobility and the factors causing it.

Factors causing mobility:

- Inflammatory changes in the periodontal ligament.
- Traumatic occlusion
- Loss of attachment
- A combination of all the three.

Treatment planning:

Treatment planning is divided into three phases:

First phase: Initial disease control therapy.

Second phase: Definitive periodontal surgery.

Third phase: Recall maintenance.

First phase: This phase consists of reducing local etiologic factors by:

- a. Oral hygiene instructions

- b. Scaling
- c. Root planing and polishing
- d. Endodontics
- e. Occlusal adjustment and
- f. Temporary splinting.

Oral hygiene instructions

The patient should be instructed to use disclosing wafers, soft nylon toothbrush and unwaxed dental floss apart from the normal oral hygiene instructions such as correct brushing technique etc.

Scaling and root planing

The use of ultrasonic instrumentation for calculus removal followed by root planing with sharp periodontal curettes is recommended.

Overhanging margins (of amalgam alloy and inlay restorations)

Overhanging crown margins and open contacts leading to food impaction should be corrected before definitive prosthetic treatment.

Traumatic cuspal interferences

Should be eliminated using grinding procedure to establish a positive planned intercuspal position that coincides with centric relation.

Interferences in working and nonworking sides should be removed.

Second phase: After initial therapy is completed, the patient is re-evaluated for the definitive surgical phase.

Indications for surgical procedures

1. Pocket elimination was not achieved by scaling and root planing.
2. Gingival recession.

3. Lack of attached gingiva.
4. Furcation involvement.
5. Underlying osseous defects.

Other situations needing periodontal treatment

1. Pocket depth in excess of 1 mm with furcation involvement.
2. Gingivitis.
3. Marginal exudate.
4. Less than 2 mm of attached gingiva.
5. High frenal attachment.
6. Bone loss.
7. Mobility.

Pocket elimination is achieved by

1. Shrinkage.
2. Surgical excision.
3. Gingivectomy.
4. New attachment procedures.

Gingivectomy

Indications

- a. Supra-bony pockets of fibrotic tissue exist.
- b. Absence of deformities in the underlying bony tissue with pocket.
- c. Pocket depth confined to the band of attached gingiva.

Contraindications

- a. If osseous deformities are present.
- b. If pocket depth traverses or approximates the mucogingival junction.
- c. In gross gingival recession.

Periodontal flap

Two commonest used flaps techniques are:

a. Modified Widman flap

This is a more conservative surgical procedure than full-thickness flap.

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Indications

- When periodontal pockets are 4 to 6 mm in depth.
- When osseous loss is primarily of the horizontal type.

b. Full-thickness mucoperiosteal flap

This can be replaced in its pre-surgical position, or can be apically replaced.

Indications

- When surgical area has pockets of 6 mm or more with osseous defects.
- In case crown lengthening is required.

Reconstructive surgical procedures:

1. Laterally replaced flap.
2. Edentulous area pedicle flap.
3. Double papillae repositioned flap.
4. Free gingival graft.

Indications

- a. In establishing a zone of attached gingiva on abutment teeth.
- b. In cases with less than 1 mm of attached gingiva.

Third phase:

- Includes reinforcement of plaque control measures.
- Debridement of all root surfaces of supragingival and subgingival calculus and plaque by the dentist.
- A 3 to 4 month recall system.

Advantages of periodontal therapy

1. Elimination of periodontal disease enhances the long-term success of dental treatment.
2. Periodontium free of disease enhances restorative corrections.
3. Elimination of periodontal pockets establishes a normal gingival contour on the tooth surface.

4. Coronal contours and gingival margins of restorations can be placed with accuracy.
5. Aids in evaluating a tooth before a final decision is made to include it in the partial denture design.
6. The dentist can analyse the degree of cooperation to be expected from the patient during the restorative phase.
7. Preservation of tooth is possible, which could have otherwise failed.
8. Crown lengthening procedures enable the tooth to distribute forces more uniformly.

DUAL IMPRESSION

Importance of dual impression procedure

1. If pressure free single impressions are used to fabricate distal extension partial denture then excess pressure is exerted onto the abutment tooth.
2. A dual impression technique equalizes forces on the edentulous ridge and abutment tooth.
3. Dual impression copies edentulous ridge in functional form and tooth in anatomic form.
4. Distributes load over large area.
5. Defines the peripheral extension of denture base accurately.

Various dual impression techniques

1. McLean's physiologic impression.
2. Hindel's method.
3. Fluid wax functional impression.
4. Selective pressure impression technique.

McLean's physiologic impression: This technique is used in distal extension partial dentures (as in Kennedy's Class I and II situations) to record the tissues of the residual ridge that support a distal extension denture base in its functional form.

Procedure

1. Custom impression tray is constructed over a preliminary cast of the arch.

2. Border moulding is carried out on the edentulous portion of the tray borders and a functional impression of the distal extension ridge is made with zinc oxide eugenol impression paste.
3. Hydrocolloid impression is made with a stock tray placed over the first impression, which is positioned in its functional position with finger pressure.

Disadvantage

Finger pressure cannot produce the same functional displacement of the tissue that biting force produces.

Hindel's method

The technique is same as McLean's method except that Hindel modified the stock tray for the second impression, which was provided with holes on both sides in the molar region so that finger pressure could be applied through the tray as the hydrocolloid impression was made.

Differences from McLean's technique

- Hindel's technique was an anatomic impression of the ridge at rest made with a free-flowing zinc oxide-eugenol paste.
- When the hydrocolloid second impression is made, finger pressure is applied through the holes in the tray to the anatomic impression. The pressure is maintained until the alginate sets.
- Functional loading is achieved by finger pressure on the preliminary impression through the holes in the stock tray while making the second impression.

Disadvantages

The displaced or functional form technique can cause interruption of blood circulation with adverse soft tissue reaction and resorption of the underlying bone.

When the patient's teeth come together, the artificial teeth contact first and the remaining natural teeth contact only after the mucosa has been displaced. This is uncomfortable to many patients.

Fluid wax functional impression: The term fluid wax denotes waxes that have the ability to flow at mouth temperature.

Types of waxes that can be used

- Iowa Wax, developed by Dr. Smith.
- Korecta Wax No. 4, developed by Drs. O.C. and S.G. Applegate.

Korecta wax No. 4 has better flow properties than Iowa wax.

Objectives of this technique

1. To obtain maximum extension of the peripheral borders of the denture base.
2. To record the stress-bearing areas of the ridge in their functional form and remaining tooth in their anatomic form.

Uses of fluid wax technique:

1. Used to make a reline impression for existing partial denture.
2. To correct the distal extension edentulous ridge portion as in altered cast technique.

Selective pressure impression technique:

1. The physiologic impressions produce generalized displacement of the mucosa, whereas selective pressure directs the occlusal load to selected areas.
2. Selective pressure impression technique equalizes the support between the abutment teeth and the soft tissue.
3. Selective pressure technique helps to direct forces to the portions of the ridge capable of withstanding the force. This is obtained by providing relief in the impression tray with an acrylic bur in selected areas and permitting the impression tray to just allow space for impression material in other areas.
4. The relief areas (such as the crest of the ridge in mandibular, incisive papillae and median palatine raphe in maxillary) will be the least displaced.

5. At the areas the tray contacts, the tissues will have maximum displacement (such as buccal shelf area in mandibular, slopes of the ridge and posterior palatal space).
6. Fluid wax functional impression technique and the selective pressure technique impressions displace edentulous ridge in certain areas as selected and the master cast is altered to accommodate the altered ridge impression.
7. Hence, this technique is also referred to as the altered cast impression technique or the corrected cast impression technique.

CLOSED MOUTH IMPRESSION

Closed mouth techniques record the tissues in their functional position.

- In closed mouth technique pressure is applied by closing against occlusion rims or teeth that are attached to the impression trays, by the patient.
- Other muscle actions as swallowing, grinning, or pursing the lips are also done, while the impression material moulds and records the tissue surface.

Significance

This technique is capable of trimming the lingual borders of the lower as the tongue movements are more forceful when the teeth are together than when the mouth is open. (Macmillan, 1947)

Impression materials used for this technique are

- a. Impression compound.
- b. Waxes that flow at mouth temperature.
- c. Soft liners.

Disadvantages

1. Soft tissues displaced by this impression technique tend to rebound to their undisplaced position when the forces are released. This unseats the denture.

2. As the denture is constantly held in a displaced position, the pressure limits the normal blood flow.
3. Excessive bone resorption as due to lack of proper blood flow.
4. Inadequate retention.
5. Often the dentures made with closed-mouth impressions are overextended and must be arbitrarily trimmed.

Soft liners are good for refitting complete dentures and also possess the advantage retaining compliance for many weeks, good dimensional stability and excellent bonding to the resin denture base.

IMPRESSION TRAYS

Defined as a device which is used to carry, confine and control the impression material for making an impression.

Types

1. Stock trays
 - a. Edentulous trays
 - i. Perforated
 - ii. Non-perforated
 - b. Dentulous
 - i. Perforated
 - ii. Non-perforated
 - iii. Rimlocked
2. Custom trays or Special trays

To make corrective or final wash impression.

Materials used

- Shellac
- Tray Compound
- Acrylic resin (with spacer and stops)
- Metallic (stainless steel)

Functions of impression trays

1. To support the impression material while in contact with oral tissues.

2. For various impression techniques as selective pressure technique.
3. To support the impression material so that cast can be poured.

For successful impression knowledge of the following is necessary

1. Oral anatomy.
2. Impression materials.
3. Impression technique.
4. Operator skill.

Custom made tray

Ideal requirements

1. Material should be rigid and dimensionally stable.
2. Accurately and closely adapting to oral tissues.
3. Impression material should adhere to the tray.
4. There should be sufficient space between vestibular sulcus and tray border.
5. Should be strong enough to carry impression material.

FLUID WAX FUNCTIONAL IMPRESSION

The term fluid wax denotes waxes that have the ability to flow at mouth temperature.

Types of waxes that can be used

1. Iowa Wax, developed by Dr. Smith.
2. Korecta Wax No. 4, developed by Drs. O.C. and S.G. Applegate.

Korecta wax No. 4 has better flow properties than Iowa wax.³

Objective of this technique

1. To obtain maximum extension of the peripheral borders of the denture base.
2. To record the stress-bearing areas of the ridge in their functional form and remaining tooth in their anatomic form.

Uses of fluid wax technique

1. Used to make a reline impression for existing partial denture.
2. To correct the distal extension edentulous ridge portion as in altered cast technique.

Procedure

- a. **Impression tray** is made, attached to the framework after verifying fit of framework.
- b. **Peripheral extensions of tray are corrected** after seating the tray in the mouth. The tray should be 1 or 2 mm short of the movable tissue.

The posterior extension of the tray should end at two-thirds coverage of the retromolar pad

- c. **Border moulding the impression tray:**

The mandibular distal extension tray is border moulded in two steps:

1. From the anterior extent of the buccal flange to the most posterior extent of the tray and
2. The remainder of the lingual and distal lingual flange.

- d. **Relieving tray:**

As no relief was provided between the ridge and the tray during the fabrication of denture base, 1 to 2 mm of the tray is relieved for impression procedure.

- e. Impression procedure:

- The fluid wax impression is made with the open mouth technique.
- The impression wax is melted in a water bath maintained at 51° to 54° C within a container.
- The wax is painted on to the tissue side of the impression tray with a brush.
- Each time the tray is placed into the patient's mouth, it must remain in place for 5 minutes to allow the wax to flow and to prevent build-up of pressure, which can result in distortion.

- After 5 minutes the tray is removed and the wax examined for glossy surface indicating adequate contact.

f. Making the impression borders:

The peripheral extension:

The peripheral extension of the impression tray should be short by 2 mm to develop a proper border seal with tissue movements done by the patient.

Buccal and distobuccal borders in mandibular impressions:

Are obtained by asking the patient to open the mouth wide, which will activate the buccinator muscle and pterygo-mandibular raphe and produce the desired border.

Lingual extension for a mandibular impression:

Tongue is thrust into the cheek opposite the side of the arch being border moulded by the patient.

Distolingual extension:

The patient presses the tongue forward against the lingual surfaces of the anterior teeth.

After all the borders are copied satisfactorily the impression is replaced in the mouth for a final time for 12 minutes to ensure complete flow of wax and to release any pressure present.

New cast is poured immediately to prevent wax distortion.

Advantage

- Can produce an accurate impression if properly done.

Disadvantages

- Time consuming.
- Can cause excessive tissue displacement if not done accurately.

ALTERED CAST TECHNIQUE

This technique alters a master cast made of anatomical impression into functional impression by a second impression method utilising the metal framework as a tray.

Objectives

1. To reduce the support differential for a free-end saddle by obtaining a compressive impression of the edentulous area, which approximates functional loading.
2. To achieve uniform distribution of load from the denture to the residual ridge, which increases the dentures stability.

Methods that can utilize altered cast technique

1. Fluid wax functional impression.
2. Functional reline technique.
3. Functional selective pressure dual technique.

Fluid wax functional impression

Procedure

- a. A initial single pressure free impression is made using alginate and cast is poured.
- b. An impression tray is made, attached to the framework after verifying fit of framework.
- c. Peripheral extensions of tray are corrected after seating the tray in the mouth. The tray should be 1 or 2 mm short of the movable tissue.

Border moulding the impression tray

The mandibular distal extension tray is border moulded in two steps:

1. From the anterior extent of the buccal flange to the most posterior extent of the tray and
2. The remainder of the lingual and distal lingual flange.

Relieving tray

As no relief was provided between the ridge and the tray during the fabrication of denture base, 1 to 2 mm of the tray is relieved for impression procedure.

Impression procedure

- The fluid wax impression is made with the open mouth technique.

- The impression wax is melted in a water bath maintained at 51° to 54° C within a container.
- The wax is painted on to the tissue side of the impression tray with a brush.
- Each time the tray is placed into the patient's mouth, it must remain in place for 5 minutes to allow the wax to flow and to prevent build-up of pressure, which can result in distortion.
- After 5 minutes the tray is removed and the wax examined for glossy surface indicating adequate contact.
- After all the borders are copied satisfactorily the impression is replaced in the mouth for a final time for 12 minutes to ensure complete flow of wax and to release any pressure present.

Functional reline technique

- In this technique the secondary impression is made after the framework is constructed so it is referred as functional reline.
- This technique adds a new surface to the tissue side of the denture base.
- This can be done before insertion or later if excessive resorption is present.

Procedure

1. A soft metal spacer (Ash No. 7 metal) is adapted over the ridge on the cast before processing the metal denture base. After processing the metal is removed, leaving an even space between the base and the edentulous ridge.
2. Border moulding is done and impression is made with a low-fusing modelling plastic placed over the tissue surface of the denture base. The modelling plastic is tempered in a water bath and seated in the patient's mouth until an accurate impression of the ridge is made.
3. The entire procedure is done with the patient's mouth in a partially open position.

4. Final impression:

After the application of modelling plastic is complete 1 mm of modelling plastic is scraped away uniformly from all over the crest of ridge.

Final impression is made with a free-flowing zinc oxide-eugenol impression paste. In case of excessive undercuts an elastomeric impression material is used.

Both the above procedures and selective pressure dual impression can be converted to altered cast technique.

Preparing the original cast and pouring corrected cast

- a. Corrected cast impression can be done in 20 to 30 minutes.
- b. The edentulous areas are outlined on the cast which was made using a single impression procedure.
- c. These outlined areas are removed with handsaw.
- d. Knife-edged stone on lathe is used to make longitudinal retention grooves on cut surface of cast to provide mechanical retention for new portion of cast to be poured.
- e. Framework with the impression of either the fluid wax technique or the functional reline method is seated on sectioned cast and secured with modelling plastic.



Figure 38: Framework attached on sectioned cast

- f. Impression must not contact cast.
- g. Utility wax is used to bead impression to form land area, 2 to 4 mm below peripheral margins of impression and extending outward 3 to 4 mm from impression.
- h. Boxing wax is added around beading wax to confine dental stone.

- i. Original cast is soaked in slurry water for 10 minutes and dentrite stone is poured into the beaded and boxed portion.

After the stone sets the altered cast is retrieved with the edentulous area recorded in functional form.

PALATAL MAJOR CONNECTOR

A major connector is the unit of the partial denture that connects the parts of the prosthesis located on one side of the arch with those on the opposite side. It is that unit of the partial denture to which all other parts are directly or indirectly attached.

Palatal plate-type connector (Complete coverage)

- The best maxillary major connector in rigidity and support.
- The anterior border should either extend to the cingula of the tooth surface or be kept 6 mm short of gingival margin. The anterior border of such palatal major connectors should follow the valleys between the rugae.
- The posterior border should extend to the junction of soft and hard palate. The anterior and posterior borders should cross midline at right angles.
- Minor connectors must cross gingival tissues, at nearly a right angle while joining the major connector.

Requirements of major connector

1. Major connectors must be rigid to transfer forces uniformly over the entire supporting structures.
2. Prevents movement of the denture base by its rigidity.
3. Aids the other components of the partial denture to function effectively.
4. They should not be placed on excessively movable tissues.
5. Should not be placed in bony or soft tissue prominences.
6. Should maintain oral health.
7. All borders should taper towards soft tissue.
8. Should be made from an alloy compatible with oral tissues.

9. Thickness of metal should be uniform through out.
10. Finished borders should curve gently.
11. Metal should not be highly polished on the tissue surface.
12. All borders on soft tissue should be beaded fading out near gingival margins.
13. Should not interfere and irritate the tongue.
14. Should not alter the natural contour of the palatal vault.
15. Should not impinge on oral tissues during function.
16. Should not retain or trap food particles.
17. Aids in support, retention and stability.

Types

- a. All acrylic Resin
- b. Combination of metal and acrylic.
- c. All cast metal.

All acrylic type: The entire major connector is made of acrylic; the flanges extend to the edentulous spaces also.

Combination type: The anterior portion is made of metal to confirm to the rugae contours. This has a better adaptability.

The posterior half is made of acrylic and is attached to the metal by means of retentive loops extending from the metal. The posterior acrylic resin extends posteriorly till the junction of soft and hard palate.

All metal: Is made up entirely of metal. Anterior border should be short of gingival margin or can extend up to the lingual aspect of the tooth.

Posterior border extends to the junction of soft and hard palate.

Rules to use

1. No palatal seal can be obtained in partial denture.
2. The borders should be beaded when metal is used to prevent food entrapment.
3. The borders should never be placed on the elevation of the rugae region.

Advantages

1. Good rigidity and support
2. Better retention
3. Maximum tissue coverage
4. Can be given for bilateral distal extension
5. Better stability in flat or flabby ridges.
6. Can be designed in obturator patients
7. Design for transitional dentures (All acrylic).
8. Natural sensation during eating and drinking as in all metal.
9. Can be relined later.

Disadvantages

1. Large area of tissue coverage can cause tissue reactions such as hyperplasia.
2. Speech difficulties can occur.

LINGUAL BAR

This is a mandibular major connector. A major connector is the unit of the partial denture that connects the parts of the prosthesis located on one side of the arch with those on the opposite side. It is that unit of the partial denture to which all other parts are directly or indirectly attached.

Shape and size

A 6-gauge half-pear-shaped bar, 5 mm in width, located above moving tissues but as far below the gingival tissues as possible.

Borders

- Has two borders—superior and inferior.
- The superior border should be tapered to the tissues above, with its greatest bulk at the lower border. It is flat on the tissue side and having the greatest bulk in the inferior third.
- Inferior border of the lingual bar is slightly rounded when the framework so that it will not impinge on the lingual tissue when the denture bases rotate inferiorly under occlusal loads. The major connector should not have sharp margins.

Location

- The inferior border should be located so that it does not impinge on the tissues in the floor of the mouth during swallowing, speaking, licking the lips and other normal functions.
- The location should not interfere with the tongue at rest and cause trapping of food.
- The superior border should be located 3 mm away from gingival margins of teeth.

Minimum space required

At least 8 mm of vertical space between the floor of mouth and gingival margin is required.

Measuring the height of floor

1. The first method is to measure the height of the floor with a periodontal probe in relation to the lingual gingival margins of adjacent teeth with the tip of the patient's tongue lightly touching the vermilion border of the upper lip. (More accurate)
2. The second method is to use an individualized impression tray with its lingual borders 3 mm short of the elevated floor of the mouth and then use an impression material that will be accurately moulded as the patient licks the lips.

The inferior border of the lingual bar can be located at the height of the lingual sulcus of the cast resulting from such an impression.



Figure 39: Lingual bar

Advantages

1. Simplicity.
2. Minimal tissue contact.
3. Less plaque accumulation.

Disadvantages

1. Needs precise lab work.
2. Cannot be placed when there is less than 8 mm of lingual space.

Contraindications

1. When lingual tori exists
2. In cases of high lingual frenal attachment.
3. High elevation of the floor of the mouth during functional movements.

Modifications

1. The thickness can be altered depending on the clinical situation to acquire more rigidity. This is accomplished by underlying the ready-made form with a sheet of 24-gauge casting wax.
2. Sublingual bar: The bar shape is same as that of a lingual bar.

Location

Lying over and parallel to the anterior floor of the mouth.

Uses

1. Sublingual bar can be used along with a lingual plate if the lingual frenum does not interfere.
2. Can be used when an anterior lingual undercut exist where lingual bar cannot be used.

SWING LOCK PARTIAL DENTURES

This is a modification of labial bar major connector and first described by Dr. Joe J. Simmons in Texas Dental Journal in 1963. This is named Swing Lock as the labial bar moves around a hinge joint.

Shape

It is half pear shaped bar extending on to the labial surface and sometimes to the facial surface from a lingual plate. Swing-Lock design, which consists of a labial or buccal bar that is connected to the major connector by a hinge on one end and a latch at the other end.

Design aspect

1. Support is by multiple rests on the remaining natural teeth.
2. Stabilization and reciprocation is by linguoplate contacting the remaining teeth and by the labial bar with its retentive struts.
3. Retention is by bar-type retentive clasp arms projecting from the labial or buccal bar.
4. Relief is required below the bar.
5. Its hing like action helps its close placement to gingival tissues and also allows its placement in undercut areas.
6. Path of insertion is from lingual direction with the labial arm open.
7. Surveying is done on all remaining teeth and lingual plating is positioned above the survey line. In case of maxillary swing lock complete palatal major connector is the choice.
8. Locking device:
Right side locking device is convenient.
9. Functions:
The rest and lingual plate prevent cervical movement.
The vertical projections prevent occlusal movement.



Figure 40: Swing lock design

Labial bar design

1. The labial bar is designed with small vertical projection arms contacting the labial and buccal surfaces of teeth, gingival to the height of contour.
2. These vertical arms resemble a I or T bar.
3. The labial bar can be designed with acrylic retention components especially when resin gingival veneers are required.

Indications

- a. Extreme lingual inclination of the remaining lower premolar and incisor teeth. This should be tried to rectify by mouth preparation and restoration.
- b. Large mandibular tori.

Contraindications

- a. Poor oral hygiene.
- b. Presence of a shallow buccal or labial vestibule
- c. High frenal attachment.

Uses of Swing-Lock

1. Unfavourable tooth contours.
2. Unfavourable soft tissue contours.
3. Teeth with questionable prognoses.
4. When very few remaining teeth are present
5. When remaining teeth are mobile.
6. In maxillo facial patients.
7. In patients who have lost tooth and alveolar ridge traumatically.

Advantages

1. Inexpensive method utilising all remaining teeth for retention and stability.
2. Fixed splinting of remaining teeth.
3. Can add tooth later on without reconstruction.
4. Simple and inexpensive.

Disadvantages

1. Difficult to adapt the resin to labial surface.
2. In case of distal extension bases, they can cause unnecessary forces on the rest of teeth.
3. Poor aesthetics.
4. Bulk of connector distorts lower lip.
5. Patient discomfort.

Material of choice

Chrome alloy.

Procedure

Impression

1. Alginate impression if torn in interdental areas should be repositioned and luted with sticky wax.
2. Fit checking framework:
Using a disclosing wax, framework is fitted and occlusion checked so that no part of framework makes contact with natural teeth.

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3. Tray is fabricated for dual impression.
4. Corrected cast is done either by fluid wax or reline techniques.
5. An ideal occlusion is developed in harmony with the existing occlusion.
6. Pressure indicator paste is used to complete insertion of the prosthesis.

Post insertion observation:

- a. Oral hygiene measures should be emphasized.
- b. Distal extension bases should be relined if necessary.
- c. If lock gets loosened it can be tightened by adjusting the labial arm.
- d. If any tooth need to be replaced, the retainer is attached to major connector by soldering and the tooth can be attached to the retainer with acrylic resin.

LINGUOPLATE

Shape

It is a pear shaped lingual bar with a thin solid piece of metal extending upward from superior border of bar to the lingual surfaces of teeth.

The upper border should follow the natural curvature of the supracingular surfaces of the teeth (Scalloped appearance).

Location

- Superior border should extend to the lingual aspect of teeth.
- Inferior border can be placed as low as possible without interfering with the functional activity of the floor of mouth.
- The linguoplate should have a terminal rest at each end (commonly cingulum rest on canines or mesial fossae rest on first premolars).

Relief

Soft tissue, proximal undercuts and gingival margin sulcus area of the tooth need to be relieved.

All gingival crevices and deep embrasures must be blocked out parallel to the path of placement.
Minimal relief is required in all areas.

Material of choice

Chrome cobalt alloy.

Modification

Cut back or step back design to hide metal between wide spaced teeth. In this design the upper bar drops gingivally along the marginal ridge of tooth to cross gingiva to the other tooth and rises up the marginal ridge to the contact point.

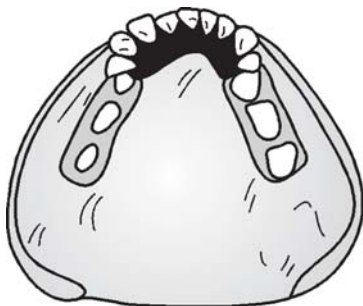


Figure 41: Linguoplate

Indications

- When the lingual frenum is high or the space available for a lingual bar is limited.
- In Class I situations in which the residual ridges have undergone excessive vertical resorption.
- For stabilizing periodontally weakened teeth (a continuous bar retainer).
- Future replacement of one or more incisor teeth can be done with the help of retention loops to an existing linguoplate.
- In wide diastemae.

Advantages

1. Can be used in class 1 situation when indirect retention is required.

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2. In periodontally weak tooth lingual plate acts as splint.
3. Can be used with some modification to prevent supra-eruption of mandibular anterior teeth.
4. Compared to other mandibular major connectors lingual plate has maximum retention, support and stability.
5. Is used when there is less lingual tissue space.

Disadvantages

1. Irritation of soft tissues.
2. Caries prone.

OCCLUSAL REST/PRIMARY REST

Definition

Rest is a rigid extension of fixed or removable partial denture which contacts a remaining tooth or teeth to dissipate vertical or horizontal forces.

Any unit of a partial denture that rests on a tooth surface to provide vertical support is called a rest.

The prepared surface of an abutment to receive the rest is called the rest seat.

Classification

Based on location:

- Occlusal rest.
- Cingulum rest/ lingual rest.
- Incisal rest.

Based on function:

- Primary rest.
- Secondary or auxiliary rest.

Occlusal rest

Shape: Triangular shape with the apex toward the centre of the occlusal surface.

Base of the triangular shape at the marginal ridge should be at least 2.5 mm for both molars and premolars. Floor of the

occlusal rest seat should be concave or spoon shaped

Thickness: At the marginal ridge should be minimum 1.5 mm. Preparation should be within enamel.

Angulation: The angle formed by the occlusal rest and the vertical minor connector from which it originates should be less than 90 degrees.

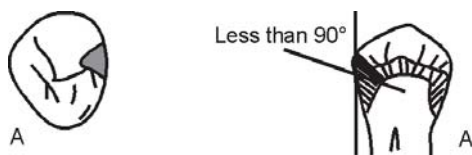


Figure 42: Occlusal rest

Method of preparation: Occlusal rest seats in sound enamel can be prepared with diamond points of the size of Nos. 6 and 8 round burs or with carbide burs.

The larger diamond is used to prepare the marginal ridge and to establish the outline form of the rest seat. The smaller diamond point is then used to deepen the floor of the occlusal rest seat and making it spoon shaped.

The unsupported enamel rods are planed by round bur and an abrasive rubber point is used to polish the preparation.

Function: As a shallow ball-and-socket joint, hence able to resist horizontal stresses to the abutment tooth.

Rules for rest seat preparations:

1. Should be prepared in enamel.
2. For effective functioning of rest, guide plane preparations should be done.
3. When a primary rest seat preparation is not adequate in function, a secondary occlusal rest should be used on the opposite side of the tooth to prevent slipping of the primary rest.
4. Occlusal rest seats in new restorations should be placed in the wax pattern.
5. Occlusal rest seats in crown and inlays should be larger and deeper than those in enamel.

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6. Occlusal rest seats supporting tooth-borne dentures are made slightly deeper than those supporting distal extension bases.
7. Occlusal rest seats must follow proximal preparation.
8. A fluoride gel should be applied to abutment teeth following enamel recontouring after the impressions are made.

Types of occlusal rests:

- Interproximal occlusal rest seats
- Internal occlusal rests.

Interproximal occlusal rest seats

Rest seats that are prepared as adjoining occlusal rest seats with preparations extending farther lingually.

Advantages

1. Avoids interproximal wedging by the framework.
2. Prevents food entrapments.

Rules for preparation

1. Contact points of abutment teeth should be preserved.
2. Sufficient tooth structure removed to allow for adequate bulk.
3. Shaped so that occlusion will not be altered.
4. Sufficient space must be created to avoid interference with placement of rests.

Internal occlusal rests

Used in totally tooth-supported situations.

Enhances occlusal support and horizontal stabilization.

Occlusal support is derived from the floor of the rest seat and horizontal stabilization from the near-vertical walls.

Preparation

1. Rest should be parallel to the path of placement.
2. Tapered occlusally and slightly dovetailed to prevent dislodgement proximally.

Advantages

1. Aesthetically pleasing.
2. Can locate rest seat in a favourable position in relation to the horizontal axis of the abutment.
3. Retention is provided by a lingual clasp arm.
4. Use of a machined mandrel made of a chromium-cobalt alloy, can be waxed into the crown or inlay pattern and casted parallel to the path of placement.

INTRACORONAL RETAINER

This is one type of Direct Retainer.

Was first formulated by Dr. Herman E. S. Chayes in 1906.

Other names

Internal attachment, or a precision attachment.

Definition

The component that engages an abutment tooth and in so doing resists dislodging forces applied to a removable partial denture is called the direct retainer.

Types

- Intracoronary Retainer.
- Extra coronal Retainer.

Parts of intracoronary retainer

It consists of two units:

- a. A receptacle that is built into a crown or an inlay constructed for an abutment tooth.
- b. An insert that is attached to the removable partial denture.



Figure 43: Intracoronary retainer

Examples of internal attachments are

- Ney-Chayes attachment.
- Stern-Goldsmith attachment.
- Baker attachment.

Function

The insert is machined to fit precisely into the receptacle.

When a masticatory load is applied to such a prosthesis, the parallelism of the retainers results in a binding action resisting dislodging forces.

Another type of retainer engages vertical walls by frictional resistance to removal.

Availability

Custom made: A cast dovetail fitting into a receptacle in the abutment crown.

Prefabricated: These are manufactured attachments.

Advantages

- Elimination of a visible retentive component and visible vertical rest support.
- Provides horizontal stabilization similar to that of an internal rest.
- Better stimulation to the underlying tissues due to intermittent vertical massage.

Disadvantages

1. Require prepared abutments and castings
2. Complicated clinical and laboratory procedures.
3. Wear, with loss of function.
4. Difficult to repair and replace.
5. Cannot use in short crowns.
6. Difficult to place within the abutment tooth.
7. Can expose pulp while preparing receptacle.
8. Expensive.

9. All horizontal, tipping and rotational movements of the prosthesis are transmitted directly to the abutment tooth.
10. Cannot be used in distal extension bases.

COMBINATION CLASP

Combination clasp is one type of extra coronal direct retainer consisting of a wrought wire retentive terminal and cast reciprocal arm. The wrought wire can be incorporated during wax up or can be soldered later on.

Definition

The component that engages an abutment tooth and in doing so resists dislodging forces applied to a removable partial denture is called the direct retainer.

Parts of combination clasp

- a. Reciprocal arm.
- b. Occlusal rest.
- c. Retentive arm.
- d. Flexible retentive terminal made of wrought wire.

Rules of use

1. The cast reciprocal arm of a combination clasp is a circumferential clasp, a bar clasp also can be used.
2. The wrought wire retentive arm is a circumferential clasp arm.
3. Depending on the choice of material for combination clasp the technique for joining the clasp to the retentive arm varies.
4. If the partial denture framework is constructed of gold or low-heat chrome alloy, the wrought wire clasp can be waxed up along with framework and the alloy can be cast directly to the wrought wire clasp.
5. If a high-heat chrome alloy is used, the wrought wire has to be soldered to the framework.

Structural difference in material

The modulus of elasticity is high for cast alloys. The structure of wrought wire is more flexible.

The greater flexibility of the wrought wire prevents undesirable forces created by the lever action of the retentive clasp tip on the abutment tooth.

Indications

- In distal extension partial denture with mesiobuccal undercut.
- In deep undercuts.

Advantages

1. Flexibility.
2. Adjustability.
3. It can be placed in the gingival third of the clinical crown of the abutment tooth, for better aesthetics.
4. Minimum of tooth surface is covered compared to a cast clasp arm.
5. Fatigue failures are less compared to a cast, half-round retentive arm.
6. The round wrought wire makes only a line contact with the surface of the abutment tooth makes it less caries prone.
7. Dissipates torquing forces exerted on the abutment tooth efficiently due to its flexibility.
8. Can be used in distal extension bases.
9. Can be placed in deeper undercuts.

Disadvantages

1. Requires additional work during laboratory fabrication.
2. Chances of breakage.
3. Easily distorted during normal handling.

4. Less bracing and stabilization compared to other circumferential clasp.

BAR OR ROACH CLASP

Definition

The component that engages an abutment tooth and in so doing resists dislodging forces applied to a removable partial denture is called the direct retainer.

Other names

- Vertical projection clasp,
- Gingivally approaching clasp,
- Push type retainer.

Types of bar clasp

Classified by the shape of the retentive terminal as:

1. T, I, and Y shape.
2. Modified T, Y and I bar.
3. Other shapes are also used.

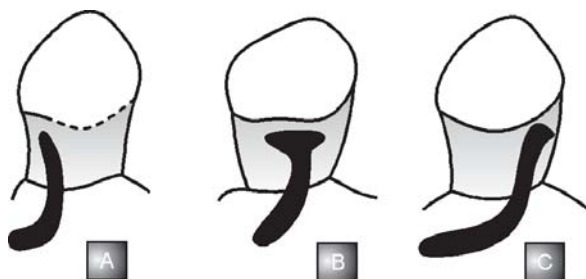


Figure 44: Types of clasp, A. I-bar, B. T clasp, C. Modified T clasp

Parts of bar clasp

1. Approach arm.
2. Minor connector.

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3. Two terminals.
 - a. The retentive terminal leaves the approach arm and extends into the undercut.
 - b. The other terminal is positioned above height of contour opposite to the edentulous area.

Location

They originate from the framework or base and approach the undercut from a gingival direction.

Rules of use

1. The approach arm should not impinge on the soft tissue as it crosses the soft tissues. The tissue side of the approach arm should be smooth and well polished.
2. Minor connector attaching occlusal rest to the framework should be strong and rigid to provide bracing.
3. The taper of approach arm should be uniform from its attachment to the clasp terminal.
4. The approach arm must never cross a soft tissue undercut.
5. The approach arm should cross the gingival margin at a 90° angle.
6. The retentive terminal should be placed in the undercut adjacent to the edentulous area.
7. The approach arm should extend on the abutment tooth to the height of contour.
8. The other terminal should be positioned above the height of contour.
9. The bar clasp should also be placed as low on the tooth to reduce the leverage-induced stress to the abutment tooth.

Types of bar clasps

A. T-Clasp:

- Used often along with cast circumferential reciprocal arm.
- The retentive terminal and its opposing terminal project laterally from the approach arm to form a T.
- Both terminals should point toward the occlusal surface of the abutment tooth.

- The retentive terminal must cross the height of contour to engage the retentive undercut, while the other terminal is placed on the suprabulge of the tooth.
- The approach arm contacts the tooth only at the height of contour.

Uses

- In distal extension ridge with distobuccal undercut.
- Can also be used for tooth-supported partial denture if the retentive undercut is located adjacent to the edentulous space.

Disadvantages

1. The T clasp can never be used when soft tissue undercut is present. (If used causes food retention and irritation to the lips and cheeks.)
2. Never to be used when the height of contour is close to the occlusal surface of an abutment tooth.
3. Not to be used in mesiobuccal undercuts.

B. Modified T Clasp:

The modified T clasp is a clasp in which only one terminal is present (only the retentive terminal).

The nonretentive (usually mesial) finger is omitted.

Uses

Used on canines or premolars for aesthetics.

Disadvantage

180-degree coverage is not present which compromises bracing and reciprocation.

C. Y Clasp

- This is commonly used when the height of contour on the facial surface of the abutment tooth is high on the mesial and distal line angles but low on the centre of the facial surface.

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- If recontouring can help to bring the survey line to the middle a T-clasp can be used.

D. I Clasp and I Bar

- Used on the distobuccal surface of maxillary canines.
- I Bar is a part of the RPI system (Rest, Proximal plate, I-bar).
- This clasp assembly consists of a mesiocclusal rest with the minor connector placed into the mesiolingual embrasure.
- A distal guiding plane, extending from the marginal ridge to the junction of the middle and gingival thirds of the abutment, is prepared for proximal plate. The proximal plate, along with the minor connector supporting the rest, provides stabilization and reciprocation for the clasp assembly.
- The I-bar should be located in the gingival third of the buccal or labial surface of the abutment in 0.01 inch-undercut.

Disadvantage

Encirclement and horizontal stabilization are compromised.

EMBRASURE CLASP OR MODIFIED CRIB CLASP

It is a type of extra coronal direct retainer.

Definition

The component that engages an abutment tooth and in so doing resists dislodging forces applied to a removable partial denture is called the direct retainer.

Design

- Two simple circlet clasps are joined at the body. The clasp crosses the marginal ridge and facial surface of both the teeth and engage undercuts on the opposite sides of the respective teeth.

- Used on side where there is no edentulous space. Embrasure clasps should have two retentive clasp arms and two reciprocal clasp arms, either bilaterally or diagonally opposed.

Indication

When spacing is present between two teeth.



Figure 45: Embrasure clasp

Rules for use

1. Occlusal rest should be prepared on both teeth.
2. Sufficient tooth structure must be removed from the buccal inclines of both teeth to accommodate for the metal thickness.
3. Contact area should not be eliminated.
4. Double occlusal rest need to be used to avoid interproximal wedging, food impaction and clasp displacement.
5. Instead of circumferential reciprocal arm an auxiliary occlusal rest or bar clasp arm can be substituted.

Disadvantages

1. Breakage of these clasps during function is common.
2. Extensive tooth preparation.
3. Difficult to get occlusal clearance.
4. Large amount of tooth surface covered that can cause decalcification and caries.
5. Minimum flexibility and cannot be used in distal extension bases.
6. Interferes with normal food flow pattern.

REQUIREMENTS OF A CLASP

The main requirements are

1. Retention.
2. Stability.
3. Support.
4. Reciprocation.
5. Encirclement.
6. Passivity.

Retention

The retentive clasp arm provides retention for the prosthesis against dislodging forces.

Retentive clasp has three parts:

- a. The shoulder, is at the proximal third, should be rigid and is positioned above the height of contour.
- b. The middle third with limited degree of flexibility engages a minimal amount of undercut.
- c. The terminal third is flexible and engages the undercut area.

Factors in retention

1. Flexibility of the clasp arm.
2. The depth that the retentive terminal extends into the undercut.
3. The amount of clasp arm that extends below the height of contour.

Flexibility is determined by

1. The length of the clasp,
2. The diameter of the clasp arm,
3. Its taper, the cross-sectional form and
4. The material from which the clasp is made.

Length: The greater the length of the clasp arm, the greater will be its flexibility. If the length of a clasp arm is doubled, its flexibility is increased five-fold.

Diameter: Flexibility is inversely proportional to the diameter of the clasp arm. A uniform taper in both thickness and width is essential. A clasp should be half as thick at the tip as at the origin.

Cross-sectional form: A round clasp has the ability to flex in all spatial planes, whereas a half-round clasp flexes only in a single plane.

Material: Chrome alloys have a higher modular of elasticity than do gold alloys and are therefore, less flexible.

Stability

It is the ability of the clasp to resist horizontal displacement of the prosthesis.

Stability is achieved by:

1. Occlusal rest,
2. Reciprocal arm,
3. Retentive arm.

Support

The property of the clasp that resists displacement in a gingival direction.

Support is attained by:

1. Occlusal,
2. Lingual,
3. Incisal rests.

Reciprocation

The reciprocal clasp arm has three functions:

1. Reciprocation against the action of the retentive arm. True reciprocation during placement and removal is possible only if guide planes are placed.
2. The reciprocal clasp arm should resist against horizontal forces.
3. Acts as an indirect retainer.

Encirclement

1. Clasp must encircle more than 180 degrees.
2. The encirclement can be continuous or broken as in bar clasp.
3. The occlusal rest reciprocal arm and retentive arm together encircle more than 180 degrees.

Passivity

Retentive function should be activated only when forces are applied.

DIFFERENCES BETWEEN WROUGHT WIRE RETENTIVE CLASP ARMS AND CAST CIRCUMFERENTIAL CLASP ARMS

Use

- Wrought wire is very flexible and hence cannot be used alone. It is used along with cast clasp as combination clasp.
- Cast clasp can be used alone but only in tooth supported partial dentures. The cast reciprocal arm of a combination is a circumferential clasp, a bar clasp also can be used.

Shape

- The wrought wire is round and can flex in all spatial planes, this aids in dissipating torquing forces exerted on the abutment tooth.
- The cast clasp is only round on the outer surface, whereas it is flat on the tooth surface, thereby limiting its flexibility.

Structure of material

- The wrought wire is linear in structure hence flexible.
- The cast alloys have slip planes limiting its flexibility.
- The modulus of elasticity is high for cast alloys compared to wrought wire.

Function

- The greater flexibility of the wrought wire prevents undesirable forces on the abutment tooth.
- As a distal extension partial denture rotates around a fulcrum, inducing stresses to the abutment tooth, a wrought wire is the choice of direct retention.
- If a cast clasp alone is used, it will cause abutment failure by transferring all the loads to the respective abutment tooth.

Undercuts

- Clasp made of chrome alloys are placed in undercut of 0.01 inch. Therefore a smaller cross-sectional form of the clasp and less retentive undercut is enough when chrome alloy is the choice.
- As internal structure of wrought wire has greater ability to flex than cast alloy, a greater depth of undercut is required for a wrought wire clasp than for a cast clasp. Eg: 0.020 inch.

Disadvantages of wrought wire

1. Requires additional work during laboratory fabrication.
2. Chances of breakage.
3. Easily distorted during normal handling.
4. Less bracing and stabilization compared to other circumferential clasp.

Disadvantages of cast clasp

1. Difficult to adjust once made.
2. Difficult to repair.
3. Needs laboratory precision.
4. Cannot be used alone in distal extension partial denture.
5. More tooth area covered, caries prone.
6. Interferes with the normal food flow pattern.

Availability

Cast clasp: 17 to 20 gauge.

Can be made of either precious metal alloys or non-precious alloys.

Wrought clasp: 18 and 19 gauge.

Nickel-chrome-cobalt wires are the commonest used.

Method of fabrication

Wrought clasp: The wire bending is easier to start from its origin. The wire curve can be bent till it coincides with the desired clasp position. The part extending beyond the intended clasp tip can be marked with wax pencil and cut off.

Cast clasp: Is not bent but is waxed. Else, prefabricated wax patterns are used.

To utilise the advantages of both, a combination clasp can be given with the retentive terminal only in wrought wire and the rest of clasp assembly in cast clasp.

Advantages of wrought alloy when used in combination with cast clasp

1. Flexibility.
2. Adjustability.
3. It can be placed in the gingival third of the clinical crown of the abutment tooth for better aesthetics.
4. Minimum of tooth surface is covered compared to a cast clasp arm.
5. Fatigue failures are less compared to a cast, half-round retentive arm.
6. The round wrought wire makes only a line contact with the surface of the abutment tooth and hence, makes it less caries prone.
7. Dissipates torquing forces exerted on the abutment tooth efficiently due to its flexibility.
8. Can be used in distal extension bases.
9. Can be placed in deeper undercuts.

Methods of attaching wrought wire to cast clasp

1. The wire can be embedded in the resin of the denture base.
2. The wire can be included in the wax-up of the framework and the metal cast to the wire.
3. The wire is contoured after the framework is complete and then attached to the cast clasp by soldering it to the framework when a high-heat chrome alloy is used.
4. The wrought wire clasp is soldered back on the retentive meshwork, away from the area where it will be required to flex.

RPI SYSTEM

The clasp system includes the three elements (Kratochvil's system)

1. Mesial Rest.
2. Proximal plate.
3. I bar.

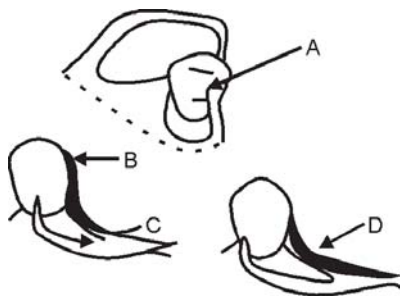


Figure 46: RPI system, A. Mesial rest, B. Proximal plate, C. I-bar, D. Krol's modification

Design

A. Rests

1. The posterior rests are placed on the mesial fossae of premolar or molar.
2. Anterior rest act as indirect retainer (cingulum rest placed on the canines generally).
3. The posterior rest in premolars are prepared in marginal triangular ridges.
4. The molar rest extends into central fossae.

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Rests are placed on mesial fossae because

- a. Anterior placement of rest helps to dissipate forces better onto the mucosa.
 - b. Mesial rest directs tipping forces mesially which is strongly resisted by the tooth adjacent to the abutment tooth.
- B. *Proximal plates:* Parallel guide planes are prepared on proximal surfaces of all teeth adjacent to the edentulous space.

Location

Extends from marginal ridge to tooth tissue surface and onto 2 mm of attached gingiva.

Functions of proximal plate

1. Reunites arch and provides horizontal stability.
2. Retention is increased.
3. Prevents food impaction.
4. Provides reciprocation.
5. Uniform distribution of forces.

C. *Direct retainer:* The retainer in RPI is I-bar.

The approach arm is long with uniform taper and crosses gingiva at 90 degree. The I-bar should be located in the gingival third of the buccal or labial surface of the abutment in 0.01 inch-undercut.

Advantages of I-bar

- a. Passive against abutment tooth.
- b. No food accumulation against tooth surface.

Disadvantage

- Less horizontal stability and retention.

Major connectors, minor connectors and saddles are designed as for normal designing.

Modification of Kratochvil's system

Krol's criteria.

1. Rest preparations are less extensive in the RPI system. The mesial rest prepared on molars and canines are often circular concave depressions prepared in the mesial marginal ridge.
2. Proximal plate is diminished in all directions and I bar retentive tips are placed mesial to the mesiodistal height of contour.
3. Occlusal force on extension base disengages proximal plate into gingival concavity and I-bar disengages into interproximal embrasure.

RPA clasp:

- Tipped abutments and tissue impingement are treated with RPA clasp (Rest, Proximal plate and Aker's clasp).
- When the Aker's clasp arm is used, all undercuts are relieved except at the retentive tip.

The requirements of a partial denture clasp system (vertical support, horizontal stabilization, retention, reciprocation and passivity) are all met by the I-bar system.

STRESSBREAKERS/STRESS EQUALIZERS

Definition

It is a device that relieves specific dental structures of part or all of the occlusal forces and redirects those forces to other bearing structures or regions.

Stress-breaker is a device that allows some movement between the denture base or its supporting framework and the direct retainers.

Other names

- Articulated prosthesis,
- Broken-stress partial denture
- Semi rigid connectors.

Location

Used between saddles and the clasps.

Types

Depending on location:

- Intracoronal
- Extracoronal.

Depending on movement:

- Hinges, Sleeves, Cylinders and Ball-and-socket devices. (Placed between the direct retainer and the denture base. Eg: Dalbo attachment and Crismani attachment).
- The articulated prosthesis (Eg: Double lingual bar, Ticonium hidden-lock design).

Advantages of stressbreakers

1. Alveolar support of the teeth is preserved as the horizontal forces are dissipated uniformly by stress breaker.
2. A balance of stress between the abutment teeth and the residual ridge is achieved.
3. Intermittent pressure of the denture bases provides physiologic stimulation, thus preventing bone resorption.
4. Need for relining is limited.
5. Even if relining is prolonged, abutment teeth are not damaged.
6. Splinting of weak teeth.

Disadvantages of stressbreakers

1. Difficult to fabricate and expensive.
2. Vertical and horizontal forces are concentrated on the residual ridge, which can increase ridge resorption.
3. If relining is needed and not done, excessive resorption results.
4. Effectiveness of indirect retainers is eliminated.
5. Food trapping and bulk uncomfortable to the patient.
6. Flexible connectors can distort by constant handling, this jeopardises the functioning of the stress breaker.

7. Repair and maintenance are difficult, costly and required often.

ACRYLIC DENTURES

The complete coverage dentures include the all-acrylic dentures.

Borders

- Anterior border should extend up to the lingual aspect of the tooth (Scalloped margins).
- Posterior border extends to the junction of soft and hard palate.

Indications

1. As interim prosthesis.
2. As an immediate denture replacing anterior teeth.
3. In young patient where growth of the jaws and dentition are not completed.
4. When remaining teeth have a poor prognosis as in a transitional denture.
5. As a treatment denture to restore tissues to original contour.
6. Where only a few isolated teeth remain.
7. In maxillofacial patients as in obturator patients.

Advantages

1. Low cost.
2. Ease of fabrication and modification.
3. Ease of repair.
4. Tooth can be added if abutment fails.
5. Better tooth bonding to acrylic resin than metal framework.

Disadvantages

1. Material is weak and less rigid compared to metal alloys.

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2. More prone to fracture.
3. Can cause allergic reactions to residual monomer.
4. It is radiolucent, difficult to locate if the denture is swallowed or inhaled.

Acrylic denture designs

1. All acrylic.
2. Spoon dentures.
3. Modified spoon dentures.
4. Combination of acrylic with metal.

All acrylic

- Is a complete palatal coverage denture with two borders.
- Anterior border should be placed on the lingual aspect of anterior tooth following the contact points.
- Posterior border is placed at the junction of soft and hard palate. This can vary depending on the edentulous span. The entire denture base including the flanges is of acrylic resin.

Modification

Can be placed along with obturator, palatal ramp and as speech prosthesis.

Spoon denture

- A spoon denture is that one that replaces one or two anterior tooth in very young patients who are awaiting definitive treatment later on.

Disadvantage

Chances of swallowing or inhaling it.

Modified spoon denture

- Modified spoon denture utilises frictional contact between the connector and the palatal surfaces of some of the posterior teeth or uses wrought wire clasps.
- Less chance of swallowing.

Combination type

- The anterior portion is made of metal to conform to the rugae contours. This has a better adaptability.
- The posterior half is made of acrylic and is attached to the metal by means of retentive loops extending from the metal. The posterior acrylic resin extends posteriorly till the junction of soft and hard palate.

Advancements

1. High impact cross-linked acrylic resins, which can withstand stress better, are available.
2. Carbon fibre reinforced acrylics have better strength.
3. Barium sulphate added to make it radiopaque.

TOOLS IN SURVEYING**Surveying**

Is an analysis and comparison of the prominence of intraoral contours associated with the fabrication of a prosthesis.

It is the study of parallelism or lack of parallelism to select path of insertion so that restorations encounter least tissue/tooth interference and will provide adequate balanced retention.

Tools in surveying

- a. Analysing rod or paralleling tool.
- b. Carbon rod or marker.
- c. Undercut gauges.
- d. Wax knife.
- e. Preparation tools to be attached to handpiece.

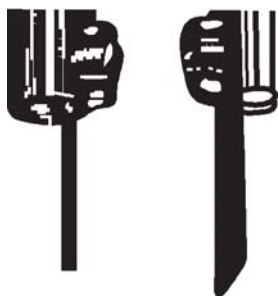


Figure 47: Analysing rod and carbon marker

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Analysing rod: This tool is used to check the parallelism of surfaces of tooth.

Check undercuts in soft and hard tissues.

Check height of contour.

Carbon marker: A carbon marker replaces analysing rod to mark:

- a. Survey lines.
- b. Other areas to be modified which are located by analysing rod.

Undercut gauges: Are used to identify specific amount and location of undercut on abutment tooth.

Under gauges are of three types – 0.01, 0.02, 0.03.

0.01 inch: retention by cast retainers.

0.02 inch: retention by tapered wrought-wire.

0.03 inch: is rarely used.

The amount of retention can be verified by a source of light, which forms a triangle bounded by the surface of the abutment tooth on one side and the surveyor blade on the other side.

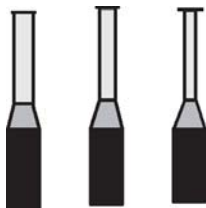


Figure 48: Undercut gauges

Wax knife: Used to eliminate or block out undercuts.

To carve waxed up cast restorations for guide plane placement.



Figure 49: Wax knife

Preparation tools on hand piece: In some surveyors a hand piece can be attached and specific burs can be used to prepare internal rest seats, guide planes and attachment slots.

TRIPODING THE CAST

Definition

Those marks or lines drawn on a cast in a single plane perpendicular to the surveyor rod to assist with repositioning the cast on a dental surveyor in a previously defined orientation.

Objectives

- a. Helps to return working cast to the surveyor in the same relation as the proposed path of placement for shaping wax patterns, trimming blockout on the master cast, or locating clasp arms.
- b. For future reference.

Methods of tripoding

First method:

- Three divergent dots are widely spaced on the tissue surface of the cast with the tip of a carbon marker and the vertical arm of the surveyor is locked in position.
- The dots are encircled with a colour pencil.
- When the cast is returned to the surveyor, the cast is tilted till the tip of the surveyor blade again contacts the three dots in the same plane. This orients the cast to the original position.

Modification of first method

Tiny pits can be formed in the cast instead of markings hence transferring this relationship to the refractory cast.

Second method

- Cast can be scored on two sides and the dorsal aspect of the base of the cast with a sharp instrument held against the surveyor blade.
- Tilting the cast until all three lines are again parallel to the surveyor blade, orients the cast to the original cast position.

Importance

1. To locate the tilt of the cast to the appropriate path of insertion and removal.
2. To reorient the master cast.
3. To reorient the cast in future.

GUIDE PLANES**Definition**

Vertically parallel surfaces on abutment teeth oriented so as to contribute to the direction of the path of placement and removal of a removable partial denture.

Location

- Guiding planes are prepared on the proximal or axial surfaces of the teeth 2 or 3 mm in occluso-gingival height adjacent to edentulous area.
- They are also contacted by the minor connectors of the partial denture.
- Can be made in tooth supported and tissue supported situations.

Common areas

- Proximal aspects of tooth.
- Lingual aspect of tooth.

Function

1. Aids in easy removal and placement of prosthesis without causing undesirable forces against the teeth.
2. They form intimate contact with the minor connectors, and stabilize denture against lateral forces.
3. They help protect weakened teeth from lateral forces.
4. Decrease wedging stresses.
5. Improves oral hygiene.
6. Contributes to retention.
7. Easy insertion and removal of the prosthesis.

Placement

The surveyor locates the proximal tooth for guide planes.

Guide planes can be placed:

- a. By selective grinding.
- b. By preparation.

- c. On restorations.
- d. On wax patterns that transfer it to cast restorations.

Rules of use

1. Should be developed parallel to the path of insertion.
2. Should be placed on enamel surface.
3. If cannot be placed on enamel surface it needs to be placed on restorations.
4. The tilt of the cast should be selected so that all the factors as retentive undercuts, guide planes are all in balance.
5. After reshaping tooth surface, the enamel must be highly polished by carborundum-impregnated rubber wheel.
6. Fluoride gel can be applied to the reshaped surfaces.

Methods

- A. Enameloplasty to develop guiding planes in tooth supported:
 1. Cast is surveyed and the path of placement is selected.
 2. The correct handpiece, with a cylindrical diamond point is positioned over the cast to evaluate the parallelism of diamond stone to the tooth. If parallel the same relationship can be duplicated in the patient's mouth.
 3. A light, sweeping stroke from the buccal line angle to the lingual line angle is used. (Five or six light strokes of the diamond stone are sufficient).
 4. The flat surface should be 2 to 4 mm in occlusogingival height.
 5. The reduction should follow a curvature of the surface.
 6. All prepared tooth surfaces must be polished and fluoride gel applied.
- B. Guiding Planes on abutment teeth adjacent to distal extension edentulous spaces:
 1. Tooth preparation same as in enameloplasty.
 2. The only difference is that the occlusogingival height of the plane is reduced to 1.5 to 2 mm to permit the

partial denture to rotate slightly around the distal occlusal rest.

- C. Guiding Planes on lingual surfaces of abutment teeth:
 - 1. This is prepared to provide maximum resistance to lateral stresses.
 - 2. Tooth preparation is the same way as for the other situations.
 - 3. The occlusogingival height of the preparation is 2 to 4 mm and should be located in the middle third of the clinical crown of the tooth.
- D. Guiding Planes on anterior abutment teeth: Is prepared to ensure stabilization, minimize wedging action between the teeth, decrease space between the denture and the abutment tooth, increase retention and restore the normal width of the edentulous space.

Indications

- 1. When teeth adjacent to the space have drifted or tipped into the space.
- 2. In cases of undercuts on tooth surface adjacent to edentulous space.

Rules

- 1. A cylindrical diamond stone is used.
- 2. If guide planes cannot be placed on enamel, restorations are used.
- E. Enameloplasty to change height of contour: When height of contour need to be changed to provide better clasp positions or for lingual plating. Ideal placement of retentive clasp arm should be no higher than the juncture of the gingival and middle thirds.

SURVEY LINES

Definition

A line drawn on a tooth or teeth of a cast by means of a surveyor for the purpose of determining the positions of the various parts of a clasp or clasps.

Objective

Marks the height of contour of the tooth. (Greatest circumference of a tooth at selected position).

Classification of survey lines

1. Ney system.
 - a. Class I.
 - b. Class II.
 - c. Class III.
2. Blatterfein system.
 - a. High survey line.
 - b. Medium survey line.
 - c. Diagonal survey line.
 - d. Low survey line.

Ney system

Class I: Runs diagonally across the tooth and is high on the far zone and low on near zone. Commonly seen in tilted premolar (survey line on one side higher than the other) and in anterior abutment especially in distal extension base cases.

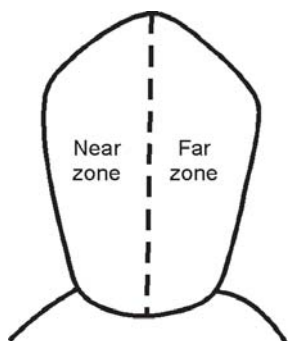


Figure 50: Near and far zones

Direct retainers that can be used

1. Cast clasp arm.
2. Back action and reverse back action clasps.
3. For lone standing molars where distal extension is not required ring clasp can be used.



Figure 51: Class I survey line

Class II: Low on the far zone and high on near zone. Gingivally approaching clasp can be used.



Figure 52: Class II survey line

Class III: Survey line is parallel to the occlusal surface just below it.

A wrought wire combination clasp with terminal two third entering the undercut can be used.



Figure 53: Class III survey line

Blatterfein system

- a. High survey line
- b. Medium survey line
- c. Diagonal survey line.
- d. Low survey line

Atypical B or high survey line: Common with inclined and large teeth.

Line is parallel to the occlusal plane and close to it.

Direct retainers that can be used are

- a. A wrought wire combination clasp.
- b. If the line is low on the opposing side of the tooth then a back-action, reverse back-action or ring clasp can be used.

Typical or medium survey line: This extends from the mid-point between the occlusal surface and gingival margin in the near zone, to a point two thirds of the distance from the occlusal surface to the gingival margin in the far zone.



Figure 54: Atypical survey line



Figure 55: Typical survey line

Direct retainers that can be used are

1. Cast clasp arm.
2. Back action and reverse back action clasps.
3. Gingivally approaching clasp also can be used.

Atypical A or diagonal survey line: Runs diagonally across the tooth surface from a high position in the near zone to a low position in the far zone.

Direct retainers that can be used are

Occlusally approaching clasps as cast clasp, reverse circumferential clasp and ring clasp.



Figure 56: Diagonal survey line

Atypical C or low survey line: Survey line is parallel to the occlusal surface but is just above the gingival margin.

To get favourable undercut

1. Place a crown, which offers a favourable undercut.
2. Place a Class V inlay, a dimple is cut and a ball head on the gingivally approaching arm positioned to engage the dimple.
3. An extended arm clasp can be used where the contiguous tooth offers favourable conditions for retention.
4. Develop undercut by grinding.

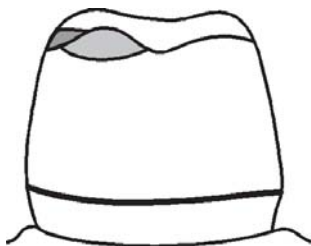


Figure 57: Low survey line

WORK AUTHORIZATION

Definition

The written instructions submitted to a dental laboratory by a dentist along with the work.

Items to be sent to the laboratory

1. Properly prepared and articulated master cast.

2. Diagnostic cast with specific design drawn on it.
3. Work authorization order.

Work authorization order should include

1. Signature of the dentist.
2. Date of the authorization.
3. Name and address of the patient.
4. Description of the kind and type of work to be done.

Objectives

1. Acts as a good line of communication between the dentist and the laboratory.
2. The technician can carry out the work according to the dentist's clinical requirement.
3. Instructions written can be clarified.
4. The quality of the work done by the dentist and by the laboratory can be improved.
5. Also serves as a legal protection form for the dentist and laboratory technician.
6. Protects the public from the illegal practice of dentistry.
7. Establishes the separate responsibility of the dentist and the laboratory technician.

Authorization Order

This is a work form that large commercial dental laboratories and practicing dentists design depending on their individual and local requirement.

Design of the form

- The form must contain the doctor's and patient's names.
- Different forms should be used for each step (Eg: framework construction, tooth setup, try-in and for processing and finishing the denture bases.)
- The form should contain work authorization number assigned by the laboratory.

- Sections for:
 1. Special instructions and remark.
 2. Tooth selection.
 3. Diagram of the case.

1. *Special Instructions and Remark section:* In this section specific instructions to serve the special biologic conditions of each patient, any specific instructions to alter rigidity, shape of lingual bar or lingual plate is to be mentioned.

2. *Tooth selection section:*

The items to be mentioned are:

- a. The type of artificial tooth.
- b. The material from which it is to be made (porcelain or plastic) is to be indicated.
- c. Shade of tooth with the shade guide that was used.
- d. Shape of the tooth and any other spacing if required between two teeth.

Section for diagram of the case

- Completely designed diagnostic casts with colour codes.
 1. Brown for metal contours.
 2. Blue for resin outline.
 3. Red/outline for relief areas.
 4. Black for the height of contour.
- The design should include an indication of the missing teeth.
- The missing teeth to be replaced by the partial denture should be completely blacked out.
- Any tooth that is missing but is not to be replaced is marked as “X” through the tooth.
- The major connector should be drawn to the full extent.
- The configuration of the clasps should be included.

Items to be listed

1. Type of partial denture (maxillary or mandibular).
2. Number of teeth to be clasped and type of clasp (circumferential cast, circumferential wire or infrabulge bar clasp).

3. Amount of retention desired expressed in thousandths of an inch from that which is normally used.
4. Any modifications as bracing or stabilizing clasps wanted with no retention.
5. All the components should be drawn in the standard colour codes.
6. Type of major connector.

All the components are available as prefabricated patterns hence thickness need not be specified.

BLOCK OUT AND RELIEF

Block out

- Defined as the elimination of undesirable undercut areas on the cast to be used in the fabrication of the partial denture.
- Block out is a procedure done on both hard and soft tissues to achieve desired path of insertion.

Steps before block out

Cast preparation

a. Beading the outline of major connector on the cast.

The major connector outline is scraped on the maxillary cast to the depth of half of the diameter of a No. 2 round bur. Beading ensures positive contact and prevents food packing beneath the major connector. Beading is not done on the mandibular major connector.

b. Application of model spray on the cast after the design is transferred.

This protects and seals the design throughout the blockout and duplication process. The sprayed cast is dried for 5 minutes.

Blockout technique

1. One sheet of soft baseplate wax with one stick of green inlay wax is melted.
2. The melted wax is applied with a spatula.

3. Blockout wax should not be placed in clasp tip areas, guiding planes and above the contour line.

Types of block out

- Tapered blockout/shaped blockout.
- Parallel blockout.
- Arbitrary blockout.

Tapered blockout/Shaped blockout

- In case of tapered blockout the blade-like device used will be tapered (usually 2 to 4 degrees) or they can be positioned to provide a range of taper by placing the cast on a specific area of the base.
- Tapered block out is mostly done for tooth-tissue-borne dentures to allow freedom of movement in function.

Parallel blockout

- The blade surface will normally be perpendicular to the surveyor base.
- All tooth-borne partial dentures are blocked out parallel to the path.

Arbitrary blockout

- Areas of undercut not involved with the framework should be blocked out as to prevent distortion during duplication.
- Areas of gross soft tissue undercuts, area of the approach arm are blocked out using soft wax or clay.
- A small amount of wax is flowed over the major connector area to decrease finishing time.

Areas to be blocked out

- a. All tissue undercuts parallel to path of placement should be blocked out.
- b. When lingual surface undercuts exist, an additional thickness of 32-gauge sheet wax should be used for block out.

- c. One thickness of baseplate wax is placed over basal seat areas for mechanical retention of acrylic resin denture bases.

Blockout and relief of master cast

- a. All undercuts contacted by teeth parallel to the path of placement, all involved gingival crevices should be blocked out
- b. Facial surface of edentulous ridge, tuberosity, retromolar pad region, crest of the alveolar ridge in mandibular, lingual surface of alveolar ridge and basal seat areas for a lingual bar need to be blocked out.
- c. Lingual bar need to be reinforced with 24-gauge wax or similar plastic pattern.
- d. All interproximal areas with under cuts need to be blocked out.
- e. Block out is required in case of elevated median palatal raphe or any exostosis crossed by the connector.
- f. A 1 mm thickness of the relief wax is placed under the retentive meshwork for acrylic resin to flow on the cast with a hot spatula. A small square wax of 2 mm is removed with a blade held at 90 degrees to the cast for a tissue stop.

Wax contouring

- 1. Excess wax is removed from beneath the height of contour and shaped using a warmed blade.
- 2. The blockout wax in the clasp tip area is contoured with hand instruments to provide a slight ledge apical to the clasp tip so that the clasp wax pattern can be placed at the correct position in the undercut area.

FINISH LINES/BUTT JOINTS

Defined as the junction between the acrylic denture base and the major connector or any polished metal surface.

As acrylic resin is processed around the latticework and minor connectors, space for these butt joints are made on both internal and external surfaces of the major connector.

In the case of nail head minor connector, there is only a single finish line as the acrylic resin is processed only on the external surface.

Types

- External Finish lines
- Internal Finish lines.

External finish lines

Definition

The junction between acrylic and the exposed metal on the polished external surface.

Rules for external finish lines

- a. They are present on the outer aspect of the major connector.
- b. External finish line must be sharp and definite with a slight undercut to retain acrylic resin to the major connector.
- c. The angle of the finish lines formed with the major connector should be less than 90 degrees.

Method of placement

Formed by placement of the wax during the waxing procedure and by carving the wax.

Location

1. Should extend onto the proximal surfaces of the teeth adjacent to the edentulous space.
2. Should begin at the lingual extent of the rest seat and continue down the lingual aspect of the minor connector on the proximal surface of the tooth.

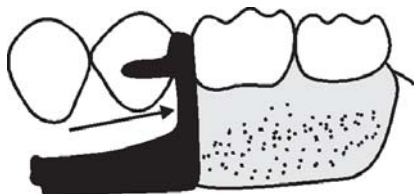


Figure 58: External finish line

Internal finish lines

Definition:

Is the space existing between the metal framework and the tissue surface of the cast.

Are present on the tissue side of the major connector.

Method of placement

1. Formed from the relief wax used over the edentulous ridges on the master cast before duplication on which the framework will be waxed.
2. A 24 to 26 gauge relief wax is placed under latticework or mesh minor connectors to create space for acrylic. This relief wax margins become the internal finish line.
3. The ledge created by the margin of the wax must be sharp and definite.
4. The finish line must have a uniform depth of at least 1 mm and be no closer than 2 mm from the abutment teeth.
5. The blade is held at 90 degrees to the surface of the cast to develop a internal finish line that is sharp with the metal-resin junction at right angles.

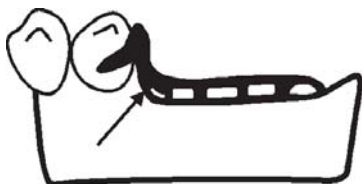


Figure 59: Internal finish line

Importance of finish line

1. To finish acrylic resin margins merging with the major connector.

2. Adequate bulk of acrylic resin can be processed uniformly increasing the strength of the material.
3. No tongue annoyance to the patient.
4. Able to polish it so that denture hygiene can be maintained.

INFECTION CONTROL IN CLINICAL PROSTHODONTICS/ SAFETY IN DENTAL LABORATORY

A. Personnel protection

This is important to prevent direct blood-borne disease transmission between patients and to the dentist itself.

Measures in personnel protection

1. Routine use of gloves.
2. Use of disposable masks and protective eyewear.
3. New masks and gloves should be worn for each patient.
4. Clinic coats should be worn during clinical procedures.
5. All medical waste products must be disposed as by the Environmental Protection rule.
6. Vaccination: Dental team need to be vaccinated against Hepatitis B (HBV).

B. Contamination barriers for equipment

As the microbes causing disease remain in an infectious state for many hours contact with these contaminated surfaces can cause cross-infection.

Measures to prevent this:

1. Use disposable instruments as far as possible.
2. Cover or shield areas that are exposed to spray. These surface covers need to be changed between patients.

Areas requiring plastic wrap are:

1. Light handle and controls.
2. Chair switches.
3. Air-water syringe.
4. Saliva ejector, soap dispenser, etc.

C. Disinfection

Chemical agents that are commonly used:

1. *Glutaraldehyde solutions*: Can be used for chemical soaking and items must be clean before immersion. Cannot be used as a surface disinfectant. Fumes of glutaraldehyde solution are an irritant and toxic. It should be used in a well-ventilated room.
2. *Iodophor solution*: Is a good surface disinfectant. The chemical may be sprayed on the surface to be treated and cleaned off using disposable paper, then re-sprayed and allowed to dry. It needs to be prepared each day.
3. *Bleaching agents (sodium hypochlorite)*: Useful for cleaning down work surfaces. The solution must be made up each day. It is corrosive to metals and irritant to the skin and toxic if ingested.

Advantages of Iodophor

- It continues its activity when left to air dry on surfaces.
- Less toxic effects.

Disadvantages

1. It stains light coloured objects.
2. Requires to be made daily.

Method of use: The surface should be sprayed, wiped with paper towels and sprayed again. The second spray should be allowed to air dry for ten minutes.

D. Instrument sterilization

Instruments which can be sterilised need to be cleaned and heat-sterilized before treating each patient.

Items that cannot be sterilised must be cleaned and treated with ethylene oxide or undiluted 2% alkaline glutaraldehyde every 30 days if not used.

Method of heat sterilisation: Instruments to be heat-sterilized are immersed in phenolic solution for 20 minutes, cleaned by scrubbing with, liquid soap, rinsed and dried.

Sterilization

- Boiling is inadequate.
- Autoclave at 134°C for more than 3 minutes.

E. Clinical sterilisation for Prosthodontics

- a. *Impression trays:* After using them they should be soaked in a detergent solution and wiped with an alcohol sponge, to remove stains and deposits.

The tray is then placed in appropriate bags and sterilized in autoclave.

The sterilized tray should be stored in its sterilization bag until its use.

- b. *Instruments, articulator, custom trays:* Laboratory knives, wax spatulas, acrylic burs, wax carvers and all equipments used in the lab need to be cleaned and sterilized following use.

Custom impression trays, baseplates, occlusion rims, articulator, mounts and trial dentures need to be disinfected after construction.

Method: Spraying with 2% glutaraldehyde and leaving it for ten minutes before rinsing is required.

- c. *Impressions:*

Alginate impressions: Should be rinsed in running tap water to remove traces of saliva and sprayed with iodophor solution. After which the impression is placed 10 minutes wrapped in plastic.

After ten minutes it should be rinsed and the cast poured. The retrieved cast after trimming is again sprayed with iodophor solution.

Final impressions: Elastomeric impressions and zinc oxide and eugenol impression material should be rinsed, placed in a container and covered with 2% glutaraldehyde for ten minutes.

d. *Denture asepsis:*

New dentures: Should be washed with a brush and germicidal soap, rinsed and dried and placed in a denture bath containing 2% glutaraldehyde disinfectant solution. The dentures should remain immersed for ten minutes. Before denture delivery the denture need to be rinsed.

JAW RELATIONS IN PARTIAL DENTURE

Type of relationships in partial denture

1. Non-contact relationships.
2. Contact relationships.

Non-contact relationships

In which teeth are apart and the mandible moves under the influence of the muscles of mastication and the temporo-mandibular joints.

In sagittal plane the interocclusal distance is wedge-shaped and 2 to 4 mm.

Types:

- A. Protrusion.
- B. Lateral movement.
- C. Rest position and freeway space.

Contact relationships

- a. *Intercuspal position (ICP):* It is the simultaneous bilateral contact of several pairs of opposing posterior teeth.
- b. *Protrusive relationship:* Incisal edges of the lower anterior teeth move against the palatal aspect of the upper incisors to an edge-to-edge incisal contact known as incisal guidance.
- c. *Retruded contact position:* This is a contact relationship in which the mandible is located 1-1.5 mm distal to the inter-cuspal position.

- d. Lateral excursion can be:
 1. Canine guided occlusion:
In lateral movement canine causes separation of all the other teeth.
 2. Group function:
In lateral movement contact is maintained between a group of teeth.

Objectives of jaw relation in RPD

1. The occlusion of the partial denture should be in harmony with the existing intercuspal relationship.
2. If there is loss of posterior teeth the jaw relation is to be recorded in centric relation.
3. The vertical relationship has to be recorded in case of posterior tooth loss.
4. If there is tooth loss with occlusal wear, vertical relationship needs to be established, as the existing relationship will be less than the normal.

Prosthesis need to be constructed at centric jaw relation when

1. Absence of posterior tooth contacts.
2. Situation in which all posterior tooth contacts are to be restored with cast restorations.
3. Only a few remaining posterior contacts.
4. Minimum alveolar support for all the remaining teeth corrected by minimum occlusal equilibration.
5. Anterior slide from centric jaw relation and symptoms of traumatic occlusion of the anterior teeth.
6. When the existing tooth is unable to provide for proper intercuspal relationship.
7. If there is excessive wear, attrition or erosion of tooth with wrong vertical relation.

Method of recording jaw relation

Fabrication of wax occlusal rims:

- Wax occlusal rims are placed on temporary bases of shellac or acrylic resin, or on cast metal frameworks.

- The stability of record bases is checked before proceeding with jaw relation record.

Adjustment of the rims

When anterior teeth are missing:

1. The rim should be evaluated for labial fullness and lip support.
2. The midline should be marked.
3. The smile line should be marked.
4. When many anterior teeth are missing the rim should be made parallel to the interpupillary line.
5. The rim width needs to be adjusted if opposing lower anterior tooth is present.

When posterior teeth are missing

1. The occlusal plane needs to be adjusted till the rest of tooth is in proper occlusion.
2. If it's a Class 1 situation with no occlusal stops, the occlusal plane need to be adjusted parallel to ala–tragal line.
3. The width of the rim should be adjusted to indicate the correct buccolingual positioning of the teeth.
4. The lower rim is also adjusted until it indicates the position of the teeth in the neutral zone.

After the final adjustments the rim should not compress the mucosa or the wax of the rim.

Recording jaw relation

The technique for recording jaw relations by Beckett (1954):

Type A

There is sufficient occlusal contact to render the relation of the upper and lower casts.

Type B

If there is insufficient occlusal contact then occlusal rim can be used as in the Class I and Class III saddle area.

Type C

Occlusal contact is present but not sufficient to permit placing the cast in the correct centric relation.

Type D

There is no occlusal contact between opposing teeth and wax rims are used to record centric and other relations.

- If occlusal stop is present, jaw relation is recorded in centric occlusion.
- If occlusal stop is not present then jaw relation is recorded in centric relation.

Jaw relation in centric relation*Evaluate*

1. The resting vertical dimension
2. The occlusal vertical dimension of the rims
3. Observe for adequate freeway space.

Registration of record

1. 2 mm of wax is removed from the lower occlusal rims to provide space for the registration material.
2. A recording medium such as impression plaster, modified zinc oxide/eugenol paste is used to record the centric jaw relation. The patient must close into the retruded jaw relationship until the recording medium sets under minimal pressure.

Verifying the record

After trimming, the shallow indentations of the record are verified in the patient's mouth or on an articulator if face-bow is mounted.

TRY-IN OF PARTIAL DENTURE

Try-in is a step to confirm the function, aesthetics and patient comfort.

In cast partial dentures there are two try-ins:

- a. For the framework.
- b. For wax try-in of the partial denture.

Objective

To verify the aesthetics and function of the try-in denture.

Try-in to verify aesthetics

Factors to be checked are:

1. No force should be applied on the try-in denture.
2. Any interference in seating of denture should be checked.
3. Anteroposterior position of anterior tooth.
4. Vertical and horizontal relation of the anterior tooth.
5. Lip support and fullness.
6. Lip length and length of teeth tips visible.
7. Smile line.
8. Space between two abutments and their mesiodistal width.
9. Check for diastemae and other spacing else where in the arch.
10. Difficulties in speech if any.
11. Vertical alignment of tooth.
12. Midline.
13. The position of first premolar if it is to be replaced.
14. Tooth shade to be checked in different light sources.
15. Ask patients opinion regarding aesthetics and comfort.

Try-in to verify function***Occlusion***

1. Check if buccolingual positioning of artificial teeth is within neutral zone or the natural occlusion.
2. Check anteroposterior relationship of teeth.
3. When teeth are placed adjacent to the minor connectors, the contact should be ground to obtain good adaptation.

Verification of jaw relation

1. If there was difficulty in obtaining jaw relation, during try in it needs to be verified.
2. When partial denture is opposed by complete denture, the jaw relation needs to be checked.
3. When posterior tooth are absent jaw relation is to be recorded.
4. By using a recording medium as impression plaster, modified zinc oxide/eugenol paste the centric jaw relation made can be verified on the articulator.

Final trial of the denture

1. The dentures should be stable and not rock on pressure.
2. Fit should be accurate.
3. Occlusion of the natural and artificial teeth should give even contact of all the occluding teeth in centric occlusion.
4. Aesthetics should be satisfactory to patient.

METHODS FOR ESTABLISHING OCCLUSAL RELATIONSHIPS IN PARTIAL DENTURE**The various methods include**

1. Direct apposition of casts.
2. Interocclusal records with posterior teeth remaining.
3. Occlusal relations using occlusion rims on record bases.
4. Jaw relation records made entirely on occlusion rims.
5. Registration of occlusal pathways.

Steps before establishing occlusal relationship

- Take a tentative jaw relation (inter-cuspal position or centric relation) and use a face-bow mounting of the maxillary cast.
- A semi adjustable articulator needs to be used for face-bow mounting. (Hanau 183-2, Dentatus model or Whip-Mix 2200).
- Mouth preparations including occlusal adjustment of the natural dentition, if indicated.

Any of the following conditions should be present before occlusal relation is recorded:

1. Centric relation and intercuspal position coincide.
2. Centric relation and intercuspal position do not coincide but the restoration is planned to be made in intercuspal position.
3. Posterior teeth do not contact and the restoration is to be fabricated in centric relation.
4. Posterior teeth are absent and the denture will be fabricated in centric relation.

Methods of establishing occlusal relationships

- A. Direct apposition of casts: The occluded casts should be maintained in same position by sticky wax until securely mounted on the articulator.

In this technique

1. Existing vertical dimension and any occlusal disharmony present is copied.
 2. Occlusal analysis and the required correction need to be done before jaw relation is done.
- B. Interocclusal records with posterior teeth remaining: Sufficient teeth are present, but the relation of opposing teeth does not permit occluding of casts. Jaw relations must be established with help of interocclusal record mediums. (Impression plaster, modified zinc oxide/eugenol paste or waxes).

Wax records:

Wax records are the least accurate. If waxes are used they need to be reinforced with an impression paste.

- C. Occlusal relations using occlusion rims on record bases:

Points to evaluate:

- a. Stable record bases need to be used-Record bases can be stabilised by using final impression materials.
- b. For more accuracy record bases can be made in autopolymerizing resin by sprinkling method.

Methods for recording centric relation on record bases:

1. Wax rims
2. Modelling plastic occlusion rims.

Wax rims

Wax occlusion rims are reduced in height until the vertical relation is adequate and a recording medium is used to record the jaw relation record.

Modelling plastic occlusion rims:

Modelling plastic occlusion rims are softened and tempered until a acceptable occlusal record is made.

- D. Jaw relation records made entirely on occlusion rims: The fourth method is used when no occlusal contact exists between the remaining natural teeth, as when an opposing maxillary complete denture is to be made with a mandibular partial denture.

Recording technique:

The occlusal rims are adjusted till the vertical relation is attained.

After which jaw relation can be recorded by

- Direct interocclusal method
 - Extraoral tracing.
- E. Registration of occlusal pathways: The fifth method of establishing occlusion on the partial denture is the registration of occlusal pathways with the use of an occluding template.

Rules of procedure:

If partial dentures are to be made in both arches, the maxillary arch is restored first and then the mandibular partial denture is occluded to the maxillary partial denture.

If a complete denture opposes a partial denture, the complete denture is done first before establishing the occlusion on the opposing partial denture.

Step by step procedure

- After the framework is adjusted to fit the mouth a denture base with wax occlusion rim is fabricated.

- The base can be made of metal or resin.
- A layer of sticky wax is placed on the base before the wax occlusion rim is made on it.
- Peck's purple hard inlay wax can be used to fabricate the occlusal rims.
- The occlusal rim should be wide and high enough to record all extremes of mandibular movement and should maintain positive contact with the opposing dentition.

Advantages

1. Teeth are modified to accept every possible eccentric jaw movement.
2. Eliminates the need to use extraoral tracing devices.
3. Accurate.
4. Occlusion thus established will have complete harmony with the opposing natural or artificial teeth.

Disadvantages

1. Opposing teeth need to be cleaned as wax particles accumulate on it.
2. The patient needs to understand the mandibular movements.
3. Procedure takes long as wax need to be added to deficient areas as patients start the mandibular movements.
4. Need to correct occlusal plane irregularities before this technique is done.
5. Registration of occlusal pathways requires a completely intact opposing arch.
6. Takes more appointments to complete the procedures.

Final result of registration

After 24 hours, the occlusal surface of the wax rim should be glossy.

After a second 24 to 48 hour period of wear, the registration should be complete.

SPEECH AIDS

Definition

A speech aid is that portion of a prosthesis that extends into the palatopharyngeal area to primarily treat speech difficulties commonly caused by cancer surgery and congenital cleft palate.

Types

1. Modified prosthetic palates made of acrylic resin
2. Palatal lifts with palatal extension made of part metal and part acrylic.

Functions of speech aid

- Helps the patient to control nasality and nasal emission of air.
- Prevents reflux of food into the nasopharynx.
- Functions of speech, mastication and swallowing are restored.

Parts of a speech aid

- a. Palatal part:*** Consist of obturator-like bulb or a maxillary palatal midline extension. The palatal coverage provides stability and anchorage for retention.
- b. Palatal extension:*** A lift raises the soft palate structures physically and promotes palatal function.
- c. Pharyngeal part:*** Fills the velopharyngeal and maintains seal during function.

Requirements

- Should improve the quality of speech.
- Must be easy to clean.
- Lightweight.
- Comfortable.

Materials Used

1. Acrylic or metal with an acrylic lift or bulb portion.
2. Acrylic resin palatal lift.
3. Acrylic with silicone extending into soft palate area.

Procedure for acrylic prosthetic palates

1. Impression is made using elastomeric impression material.
2. The cast is poured with stone, and a special tray is made to build the obturator bulb with impression compound or free flowing waxes.
3. Cast is poured and wire clasps with distal undercuts such as Adams clasps or C-clasp is made.
4. Survey the teeth and block them out.
5. Wax up the entire prosthesis; process it in acrylic. The bulb area alone can be closed out last with self-cure acrylic resin to make it hollow.

Metal framework with reinforced acrylic posterior extension*Procedure*

1. After adequate block out, use distal retention by means of clasp and complete the wax-up on a refractory model.
2. Make a metal extension posteriorly by means of a wax pattern similar in shape to a mandibular lingual bar with retention placed in the posterior segment.
3. Relief is provided below the extension for the resin to encompass the distal extension retentive area.
4. The palatal major connector and the distal extension are cast separately and soldered later on.
5. Cast, finish and try-in the framework.
6. Palatal extension can be moulded with compound or wax to get the adequate amount of lift.
7. An altered cast is made and the tailpiece can be re-soldered if required.
8. The moulded palatal extension area can be processed in acrylic or silicone.

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Disadvantage of palatal extension in metal: As the metal is rigid, it cannot move along the movements of soft palate, hence a flexible wire can be used instead.

DIRECT INDIRECT RETENTION

It's a tooth tissue support situation in which indirect retention is achieved by covering the tissue areas anteriorly for support, apart from using direct retainers.

Rugae support

Coverage of the rugal area of the maxillary arch aids in indirect retention, since the rugal area is firm and usually well situated to provide indirect retention for a Class I denture.

Though rugae coverage can improve support of a denture, the tissue support is less effective than positive tooth support.

Situations requiring direct indirect retention

1. Class I maxillary arch with palatal tori, requiring a major connector design such as the horseshoe design. As the posterior retention is usually inadequate, the requirements for indirect retention are greater than that can be achieved by tissue support alone.
2. In the mandibular arch, retention from the distal extension base alone is usually inadequate to prevent lifting of the base away from the tissues.
3. Any type of major connector, apart from complete coverage, requires indirect retention in form of tissue support (especially in Class I and Class II situations).

FUNCTIONS AND REQUIREMENTS OF MINOR CONNECTOR

Definition

A minor connector is the connecting link between the major connector or base of a removable partial denture and other units such as clasps, indirect retainer and occlusal rest.

Functions of minor connector

1. Primary function is to join all the other components as clasps, rests, indirect retainers and denture bases to the major connector.
2. Aids in efficient functioning of all components.
3. Helps to retain rests in their rest seats. This serves to transfer forces occurring against the prosthesis down the long axis of the abutment teeth.
4. Minor connector aids in uniform distribution of stresses, as it is rigid.
5. The minor connector distributes forces, onto the edentulous ridge and the remaining teeth by transferring it to several other minor connectors that serve as attachments for clasps, rests, or indirect retainers.
6. Preservation of bone.
7. In distal extension bases the minor connector is part of the saddle hence holds the artificial tooth in proper alignment.
8. Aids in retention, stability and support in a denture.

Force distribution

A minor connector distributes forces by:

1. In tissue supported prosthesis the occlusal forces applied to the artificial teeth are transmitted through the base to the underlying ridge tissues.
2. In tooth supported situation the occlusal forces applied to the artificial teeth are transferred to the nearest abutment through the occlusal rest.
3. The minor connector distributes the entire forces to auxiliary rests and to the remaining abutment teeth.
4. The minor connector is the major component of partial denture that transfers the effect of force to the retainers, rests and stabilizing components of the denture.
5. The effect of occlusal rests on supporting tooth surfaces, the functions of retainers, reciprocal clasp arms, guiding planes and other stabilizing components all resist forces and transfer it to the major connector through the minor connector.

Requirements of minor connector

1. Should be rigid to transfer stresses uniformly and to aid in the functioning of other components.
2. Should be located within an embrasure space.
3. It should join the major connector at right angle.
4. It should be thickest toward the lingual surface, tapering toward the contact area.
5. The junctions of minor connectors that join the major connector should be butt-joints.

TISSUE STOPS

Tissue stops are integral parts of minor connectors designed for retention of acrylic resin bases and stability of framework during clinical procedures.

Functions of tissue stop

1. Help interlocking of acrylic denture base to framework.
2. Stabilizes the denture during impression procedure as in fluid wax technique.
3. Seats the frame works in the same position each time for accurate jaw relation procedures and trial.
4. It maintains the relief space provided for the locking of acrylic resin.
5. Tissue stops prevent distortion of the framework during acrylic resin processing procedures.
6. Tissue stops engage buccal and lingual slopes of the residual ridge for stability.

Location of tissue stops

It is placed as a part of latticework or mesh. It is cut out from wax from the point where the posterior end of minor connector of mesh or lattice crosses the centre of the ridge.

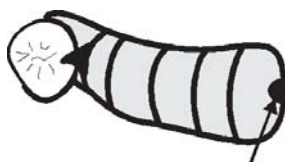


Figure 60: Tissue stop

Method of placement

- Formed from the relief wax used over the edentulous ridges on the master cast before duplication on which the framework will be waxed.
- A 1 mm thickness of the relief wax is placed under the retentive meshwork for acrylic resin to flow on the cast with a hot spatula. A small square wax of 2 mm is removed with a blade held at 90 degrees to the cast for a tissue stop.
- During the framework wax up, it is a depression.
- After casting the framework the depression is cast as a projection of lattice or mesh.
- This projection contacts the edentulous ridge and prevents the framework from distortion during acrylic packing and processing.

Other methods of placement:

- Altered cast impression procedures need tissue stops to be placed, which can be done by the addition of autopolymerizing acrylic resin.
- Another extension, which functions as a tissue stop, is located distal to the terminal abutment and is a continuation of the minor connector contacting the guiding plane. This establishes a finishing index for the acrylic resin base after processing.

BRACING AND RECIPROCACTION

Reciprocation is achieved by a reciprocal arm which resists horizontal forces exerted on the tooth by the retentive arm.

Bracing is the resistance to horizontal components of masticatory force.

Reciprocation is required as the denture is displaced occlusally while the bracing function, acts when the denture is fully seated.

Movements occurring if reciprocation and bracing are not provided

- Rotation in horizontal plane.
- Posterior movement of denture.
- Antero-posterior and
- Lateral movement.

Components that act as bracing units

- Rigid portions of clasp arms.
- Lingual plates.
- Major connectors and flanges.

Reciprocation

This is attained by a reciprocal arm.

The reciprocal clasp arm has three functions:

1. Reciprocation against the action of the retentive arm. During placement and removal, reciprocation is most needed as the retentive arm flexes over the height of contour.
2. True reciprocation during placement and removal is possible only if guide planes are placed.
3. The reciprocal clasp arm should resist horizontal forces so rigid clasp arms; rigid minor connectors and a rigid major connector should be used.
4. If reciprocal clasp arm rests on a suprabulge surface of an abutment tooth lying anterior to the fulcrum line it acts as an indirect retainer.

For effective reciprocation

1. The retentive clasp should move from its position when the denture is fully seated to where it escapes over the bulbosity of the tooth. (Retention distance).
2. The reciprocal arm on the lingual aspect should be in continuous contact with the tooth surface as the retentive arm traverses the 'retention distance'.
3. Guide planes should be prepared.

4. If the survey line is at the gingival margin of the abutment tooth, then a cross-arch reciprocation, where a retentive clasp on one side of the arch opposes a similar component on the other side is used.

ELIMINATING PROCESSING ERRORS

Limiting processing errors

- Low curing temperature can reduce shrinkage of acrylic.
- Initial heating cycle should be about 70°C. Any heating temperatures above this will cause dimensional inaccuracy.
- High levels of residual monomer should be reduced to a minimum by a terminal boil of 1 hour.
- Terminal boil should only be done after the major bulk of the monomer is converted, or porosity will result.
- A curing cycle of 7 hours at 70°C, plus 1 hour at 100°C is best.
- Should be allowed to bench cool to room temperature.
- Easily deflasked if the cast has been coated with sodium alginate.

Causes of processing errors

1. Wax that has dimensionally changed.
2. By more packing pressure the teeth is forced into the plaster.
3. Badly fitting sections of flask.
4. Thermal and polymerising changes taking place in the resin.

Method of eliminating processing errors

Selective grinding of partial dentures: Partial dentures must be ground to provide the occlusion present when designing the denture as in tooth-supported situations.

In free end saddle as in Class I and II the rules for selective grinding to provide stable occlusal contacts in centric and all eccentric relation are

1. Balanced occlusion when the jaws are in centric relation.
2. Balanced occlusion in eccentric relations:
 - On working side: By having all of the posterior teeth and the cuspids in contact.
 - On balancing side: Only the posterior teeth should contact.
3. Protrusive balance: The anterior teeth should make incisal edge to edge contact with the tips of the buccal and lingual cusps of the posterior teeth in contact.

Procedure

Locating the area of premature contact:

1. The horizontal and lateral condylar inclinations are set with the protrusive interocclusal relation record.
2. The horizontal condylar elements are released to allow freedom of the articulator in eccentric positions.
3. The incisal guide pin is raised and secured above the height of the guide table.
4. Areas of tooth contact in the centric and eccentric positions are evaluated.
5. The articulator is closed with the condylar elements against the centric relation stops until the posterior teeth are in contact and anterior teeth out of contact.
6. If the rest of tooth are out of occlusion when the lingual cusps of the maxillary posterior teeth and the buccal cusps of the mandibular posterior teeth occlude then premature contact exist.

Recording the premature contact:

After securing the right condylar element in the centric position place the lingual cusps of the maxillary posterior teeth in balancing relation with the buccal cusps of the mandibular posterior teeth.

Possible prematurities:

- a. If the balancing side is not in the correct relation, the error appears on either balancing or working side.
- b. If the balancing contact is excessive, the working side teeth will be out of contact.
- c. If the working side contact is excessive, the balancing side will not contact.
- d. If the teeth on the working side are too long, there will be no contact on the balancing side.
- e. If a single tooth is high on the working side, there will be no contact on the balancing and the working side.

Repeat the procedure with the left side as the working side and record all the premature contacts on both sides with articulating tape.

Place the tape on the occlusal surfaces and the incisal edges of all the mandibular teeth.

Steps in selective grinding procedures

Return the incisal guide pin to the table and:

1. If the cusp is high in centric and eccentric position, reduce the cusp.
2. If the cusp is high in centric and not in the eccentric position, deepen the fossae or the marginal ridges.

*For balanced gliding occlusion****Working side***

Reduce the inner inclines of:

1. The buccal cusps of the maxillary teeth and
2. The lingual cusps of the mandibular teeth.

Balancing side

Reduce the inner inclines of the mandibular buccal cusps.

Protrusive balance

Reduce the distal inclines of the maxillary cusps and the mesial inclines of the mandibular cusps.

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Refining: After the occlusal corrections are done refine the occlusal anatomy using the mounted inverted cone points and polish all the ground surfaces with pumice on a wet rag wheel.

Removal of cast: After the selective grinding is completed, the dentures are removed from their cast by sectioning the cast with a pad saw and knife.

POLISHING AND FINISHING ACRYLIC RESIN AND CAST PARTIALS

Definition

Finishing is the removal of excess restoration material from the margins and contours of a restoration and polishing of the restoration.

Polishing is the process of making a denture smooth and glossy.

Factors affecting polishing

1. Improper deflasking.
2. If separating material has not been applied correctly.
3. Improper wax up.
4. Thermal changes in curing cycle causing porosity.
5. Lack of trial closure.
6. Excessive pressure while packing and closure of flask.
7. Deteriorated investment material.

Steps in finishing

1. Initially excess acrylic resin or flash is removed with a stone in a handpiece and smoothened with sandpaper.
2. Acrylic lumps and plaster bits are removed with a sharp trimmer.
3. The posterior margin of the denture is trimmed back to the correct extension and the palate thinned if necessary.
4. Small pimples on the surface of the acrylic resin are smoothed by small stone.

Polishing

Achieved by using different sizes and shapes of polishing brushes, wheels and mops with progressively finer degrees of abrasives.

Procedure

- A rotating large bristle brush or cloth wheel wet with a slurry of pumice polishes large areas of the palate and the periphery in the buccal region in upper denture, as well as the lingual and buccal aspects in lower denture.
- For fine polishing near acrylic resin teeth and labial gum work, a small black bristle brush is used at low speed.
- In areas that cannot be reached with the brush, a felt cone is used or a small wheel brush in handpiece is used.
- Tripoli with a cloth wheel and water on a cloth mop or soft white wheel brush produces the final gloss.
- Final buffing with a swans-down mop will add high lustre.
- After polishing, the denture is to be washed in soap and warm water and stored in an antiseptic solution in a sealed polythene bag until delivered to the patient.

Rules while polishing

1. The surface of the denture must be continuously moved to avoid excessive abrasion.
2. An excess of slurry must always be kept on the denture.
3. Light pressure should be employed while polishing.
4. Ensure that polishing does not destroy the aesthetic appearance.

Types of polishing

- Electrolytic.
- Mechanical for cast partials.

Electrolytic

The casting acts as the anode of an electrolytic bath where the cathode is stainless steel. The electrolyte is phosphoric acid

and glycerine. Before proceeding with polishing, the inner aspect of clasps should be protected by a wax coating or by painting with a mixture of shellac and methylated spirit, coloured by a little dye from an indelible pencil.

Mechanical

1. A rubber wheel impregnated with an abrasive agent will impart high polish, to the casting.
2. A felt wheel or bristle brush is used to obtain a still finer surface.
3. The denture is cleaned in an ultrasonic bath to remove grease and dirt, or washed in a detergent solution.

CAUSES OF FAILURES IN RPD

Clinical causes of errors

1. When the hand mounting is done in an incorrect position as in case of Class III situation where there is posterior stop present.
2. Improper registration of centric jaw relation as in cases of Class I and II with distal extension bases.
3. Improper registering of vertical dimension.
4. Distortion of the interocclusal check records.
5. Recording relation without correcting existing malocclusion or irregular plane of occlusion.

Technical causes of errors

1. If the hand articulated cast is not luted properly. The luting should be carried out at the chairside by the clinician.
2. Gradual introduction of occlusal faults during arrangement of teeth.
3. If the tooth is not reduced adequately when space is less, the vertical dimension is increased slightly.
4. Most of the occlusal errors are unnoticed in the trial denture due to the elasticity of the wax and slack fit of the trial bases, the errors become apparent when the unyielding finished denture is fitted.

Processing faults leading to occlusal errors

1. Failure of the two halves of the flask to close perfectly.
2. Excessive packing pressure, displacing denture teeth into plaster.
3. Weak investment material.
4. Failure to remount the case on the articulator after deflasking to refine the occlusion before removing the denture from its cast.

Reasons of failure of direct retainers

1. Improper selection of under cuts depending on path of insertion.
2. Improper selection of the types of clasp to be used in each clinical situation.
3. Wrong selection of abutments for direct retention.
4. Not placing indirect retainers at the proper location.
5. Not locating the retentive terminal at the correct location.
6. When surveying and identifying survey lines are not done.
7. Distortion during fabrication of the clasp.
8. Improper placement of clasp wax pattern.
9. Wrong selection of the material, shape, cross section, diameter and taper of the clasp.
10. Improper patient instruction to remove partial dentures.
11. When clasp is stressed beyond its proportional limit.

COMPARISON OF OCCLUSAL AND GINGIVALLY APPROACHING CLASP

A direct retainer is that component that engages an abutment tooth and in doing so resists dislodging forces applied to a removable partial denture.

Comparison of occlusally and gingivally approaching clasps

1. Different names:
 - The occlusally approaching clasp is otherwise known as Akers clasp, Pull type clasp, C-clasp or circumferential clasp.

- The gingivally approaching clasp is known as Roach clasp, Push type clasp, Vertical projection clasp and bar clasp. The bar clasps are classified by the shape formed by the terminal
2. Retention:
 - The terminal third of an occlusally approaching clasp cross the survey line and enter the undercut area.
 - A gingivally approaching clasp contacts the tooth surface only at its tip and does not cross the survey line. A bar clasp is easy to insert and difficult to remove than a circumferential clasp.
 3. Bracing: The occlusally approaching clasp is more rigid and is in contact with the tooth surface above the survey line. It is capable of transmitting more horizontal force to the tooth than a gingivally approaching clasp, which is more flexible. The bar clasp does not provide as much bracing and stabilisation as C-Clasp.
 4. Appearance: Gingivally approaching clasp is more esthetic than occlusally approaching clasp.
 5. Hygiene: The gingivally approaching clasp is difficult to maintain than occlusally approaching clasp as food collection occurs under the minor connector arm.
 6. Caries: Gingivally approaching clasp is more prone to root caries where as occlusally approaching clasp cover more tooth surface area and is coronal caries prone.
 7. Periodontium: Gingivally approaching clasp harms the periodontium more than a circumferential clasp as it crosses the gingiva.
 8. Soft tissue undercuts: A gingivally approaching clasp cannot be used in soft tissue undercuts whereas a occlusally approaching clasp can be used in case of soft tissue undercuts.
 9. Tooth undercuts: The bar clasp utilises the retentive under cut adjacent to edentulous area only where as C-clasp can use any undercut depending on clasp design. Distobuccal undercuts—Bar clasp.

Mesiobuccal undercuts——C-Clasp.

10. Contour of tooth:
 - A circumferential clasp alters the tooth contour and causes changes in food pattern.
 - A gingivally approaching clasp does not alter the food pattern flow.
11. Height of contour: In high height of contour bar clasp cannot be used but a reverse circlet clasp can be used.
12. Clearance between opposing occlusion: When there is a tight occlusion with distobuccal undercut bar clasp is preferred as it does not disturb the tooth surface.
13. Minor connector: The minor connector of approach arm is more flexible than that of minor connector arm of occlusally approaching clasp.
14. Encirclement: A circumferential clasp has 180 degree continuous encirclement where as the bar clasps have broken contact encirclement.
15. Passivity: Bar clasp more passive on tooth than C- Clasp.
16. Design aspect:
 - If there is a large undercut on a molar tooth away from the saddle area, the choice of clasp design is occlusally approaching clasp.
 - If the same undercut is present on premolar gingivally approaching clasp is the choice.

PRECISION ATTACHMENTS/SEMI-RIGID CONNECTORS

Definition

A precision attachment is a mechanical device for fixation, retention and stabilization of dental prosthesis.

Classification

1. Based on fabrication:
 - Semi precision.
 - Precision.

2. Based on function:
 - Resilient.
 - Non- Resilient.
3. Based on location/placement:
 - Intracoronal.
 - Extracoronal.
4. Based on E.M. Selector.

Function

1. Relieves dental stress from occlusal forces and redirects those forces to other bearing areas that can tolerate stresses better.
2. When cross arch stabilisation is required for weak periodontal teeth.

Indications

1. Used for tooth supported dentures.
2. When other direct retainers cannot be used.
3. Over dentures.
4. In combination with implants.
5. For stress equalisation.

Contraindications

1. Poor mental attitude.
2. Poor oral hygiene.
3. Uneducated patients.
4. Limited vertical, buccal, lingual, mesiodistal or inter-proximal spaces.

Advantages

1. Aesthetic.
2. Retention in over denture.
3. Improved leverage management.
4. No need for indirect retention.

Disadvantages

1. Expensive.
2. Increased bulk.
3. More chair time.
4. Wear and damage to parts.
5. Extensive preparation of abutment.
6. Difficult to repair.
7. Bone loss.

Intracoronaral attachments

Parts: A flange and a slot.

The flange is joined to one section of the prosthesis and the slot unit is embedded in a restoration forming part of another section of the prosthesis.

Types of intracoronaral attachments:

- Retention entirely by friction. (McCollum intracoronaral unit).
- Retention by a mechanical lock. (Schatzmann unit).

Extracoronaral attachments

Are attachments having part or all of their mechanisms outside the crown of a tooth.

Parts

- a. Projection units:
Attached to the proximal surface of a crown
 - Those that provide a rigid connection (Conex attachment).
 - Those that allow some movement (Dalbo unit).
- b. Connectors:
Connect two sections of a removable prosthesis and allow some movement.
- c. Combined units:
Extracoronaral hinge type unit connected to an intracoronaral attachment.

Types:

- A. Stud attachments:
 - Dalbo stud unit.
- B. Bar attachments:

Bar Joint

These units allow play between the denture and bar (Eg. The Dolder Bar Joint.)

Bar Units

With these attachments the sleeve/bar junction is rigid. Single or multiple sleeves may be used with either category.

Auxiliary attachments

1. Screw units

These devices are useful for securing and dismantling parts of a prosthesis in the mouth, when there is no common line of insertion of the whole.

They are particularly useful for joining the two components of a telescopic crown.

2. Friction devices

Spring-loaded plungers are commonly employed to increase retention between the two sections of telescopic prosthesis.

Split posts can be used in conjunction with sectional dentures (Eg. PW Split post).

3. Bolts

Bolt units are used to connect the two parts of a sectional denture in the mouth. Each part of the denture is inserted separately and patient locks them together with the bolt.

4. Hinged flanges

This type of device allows mucosal undercuts and interdental spaces to be used for retentive purposes (Eg. A Swing-lock prosthesis).

SADDLES

Definition

A saddle is that part of a partial denture which rests on and covers the alveolar ridge and which includes the artificial teeth and gum work.

Factors in saddle designing

1. The material for the impression surface.
2. The design of occlusal surface.
3. The base extension.
4. The design of polished surface.
5. The junction between saddle and abutment tooth.

Material for the impression surface

Either metal or acrylic resin can be used or a combination of acrylic and metal can be used.

The design of the occlusal surface

1. Reduction in buccolingual width area of the occlusal table.
2. Narrow posterior teeth are used.
3. Number of teeth to be replaced is reduced if opposing tooth is absent.

The base extension

1. Maximum possible area should be covered for better retention and stability of denture base.
2. Maximum coverage is important to distribute functional forces uniformly.
3. The base should be extended to cover tuberosity region in upper and retromolar pads into the full functional depth of the buccal and lingual sulci on the lower.
4. For anterior base extension if resorption occurred is minimum than the artificial tooth can be fitted directly against the mucosa without any labial flange.

5. In case of excessive resorption labial flange need to be used.

Design of the polished surface

1. The polished surface is that surface which lies between the denture border and the occlusal surface. This surface needs to be shaped correctly for proper functioning of muscles and cheek to enhance retention and stability.
2. The denture should be placed in the neutral zone or zone of minimal conflict.

Junction between saddle and abutment tooth

Types of saddles:

1. Latticework construction
2. Mesh construction
3. Bead, wire, or nail-head minor connectors.

Open latticework construction: Consists of two longitudinal struts with smaller struts connecting the two longitudinal struts.

Maxillary design

This consists of two metal struts, 12 and 16 gauge thick.

The first extends longitudinally along the edentulous buccal ridge in maxillary arch.

The border of the major connector acts as the second strut.

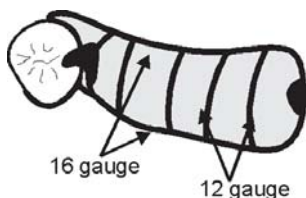


Figure 61: Latticework construction

Mandibular design

In the mandibular arch one strut should be positioned buccal to the crest of the ridge and the other lingual to the crest of the ridge.

Smaller struts

16 gauge thick smaller struts, connect the two struts and form the latticework.

They run over the crest of the ridge and are positioned so that there is no interference to arrangement of the artificial teeth.

Number of small struts

Commonly one cross strut between each tooth to be replaced.

Advantages

- a. Strongest attachment of the acrylic resin denture base to the removable partial denture.
- b. Easy to reline.
- c. For multiple teeth replacement.

Mesh construction: It is a thin sheet of metal with multiple small holes that extends over the crest of the residual ridge to the same buccal, lingual and posterior limits, as does the latticework minor connector.

Indication

When multiple teeth are to be replaced.

Disadvantages

1. Difficult for the acrylic resin to flow through the small holes.
2. Mesh type is a weak attachment.

Relief

- After the wax forms of the struts are positioned on the refractory cast, a relief space is provided over the edentulous ridges for both the latticework and the mesh minor connectors.
- This relief is provided to create a space between the struts and the underlying ridge around which the acrylic resin denture base will be retained.

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Tissue stop

In distal extension partial dentures using latticework or mesh retention, the framework needs to be stabilized during the acrylic resin packing and processing.

As the acrylic resin requires some pressure to be forced through the latticework and mesh minor connectors, the framework can displace or distort, hence a tissue stop is required to support the terminal portion of the minor connector.

Bead, Wire, or Nailhead Retention

- The bead, wire, or nailhead minor connector is used with metal denture bases.
- No relief is provided beneath the minor connector as the acrylic resin mechanically bonds with the nail head or bead of the minor connector.

Mechanical retention

- Can be made by placing beads of acrylic resin polymer on the waxed denture base and investing and casting these beads.
- Wires or form of nailheads that project from the metal base can be used.

Disadvantages

1. It is difficult to adjust the metal base.
2. Cannot be relined in case of ridge resorption.
3. Weakest of the three types of attachment.
4. Can be only on tooth-supported, well-healed ridges.
5. Cannot use when interarch space is limited.
6. No strength to withstand the forces of occlusion.

Advantages

1. Hygienic because of better soft tissue response to metal.
2. Function successfully as better fit than acrylic denture base.

SOLDERING

Definition

It is the joining of metals by use of a filler metal, which has low fusion temperature than that of the metal parts being joined.

Types

- Hard solder and soft solder.
- White alloy solder is used for nickel-chromium wires.
- For gold wires a gold solder with a melting point 50°C less than the melting point of the wire is used.
- For chrome alloys solders of the same material with low temperatures are used (Cobalt-chromium-nickel solders).

Composition of solders

Gold, Silver, copper, zinc and tin.

Requirements of solder

1. Should resist tarnish and corrosion.
2. The fusion temperature of solder should be lower than metal.
3. Should be free flowing with proper adhesion to metal.
4. Solder should not cause pitting of soldered joint.
5. Strength of solder should be equivalent to the parts to be soldered.
6. Colour of solder should match the parts to be soldered.
7. It should be corrosion resistant.
8. It should have adequate mechanical properties to withstand the forces.
9. It must have a low surface tension when molten.

Fluxes

Are used to dissolve surface impurities and protect the surface from oxidation while heating.

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Composition: Potassium fluoride and borax.

Once the soldering is complete, the denture is cleaned of any flux and the soldered areas stoned down to the final shape. The casting is then returned to the master cast for final shaping of the clasp.

Anti-fluxes

Are placed on the material before soldering flux is applied, to confine the flow of molten solder.

Soldering in removable partial denture

1. For the addition of wrought clasps.
2. When large number of components is present, the framework is separately cast and soldered.
3. In repair of clasps.
4. In case of errors that area can be sectioned, reseated and soldered.
5. Soldering precision attachments.

Soldering techniques

- Torch soldering.
- Oven soldering.
- Electro-soldering.
- Microwelder.

Advantages of oven soldering/electro-soldering over torch soldering:

1. Temperature is uniform through out the procedure.
2. The temperature is known through out the procedure.
3. Application of vacuum can control oxidation
4. Close monitoring is possible.

Electro-soldering technique:

1. Easier to use than torch soldering.
2. Permits the use of very high fusing alloy solders.

Fluxes

Fluxes containing fluoride must be used.

Method

1. The electro-soldering machine is a step-up transformer with two terminals, one copper and one carbon.
2. When the carbon tip is placed on the solder and the copper tip on the framework, a short distance from the soldering area, the electric circuit is completed through the framework and the electric energy dissipated as heat to melt the solder.
3. Normally no finishing is needed on the soldered clasp if it is to be enclosed in the denture base resin.

Soldering with the microwelder:

1. After placing the wrought wire in position the two parts to be soldered are coated with a flux.
2. The flux is allowed to dry and the solder is then applied to the joint which, when heated, will draw the molten solder into flame and surround the wires being soldered.
3. If gold platinized wires are used, heat treatment is required to attain the optimum mechanical properties.
4. If a highly platinized wire is used, heat treatment is not necessary.

The addition of wrought clasps

Common types of wrought wires used are the platinized gold alloy wire of 1 mm in diameter or a 1mm nickel-chromium wire. Attaching these wires to cast clasp is done before polishing.

Method of wire bending in wrought alloys:

1. The wire bending is easier to start from its origin than its tip.
2. The wire curve can be bent till it coincides with the desired clasp position as grooved in the wax pattern during the waxing-up stage.
3. Part extending beyond the intended clasp tip can be marked with wax pencil and cut off.

Methods of attaching wrought wire to cast clasp: If the partial denture framework is constructed of gold or low-heat chrome alloy, the wrought wire clasp can be waxed up along with framework and the alloy can be cast directly to the wrought wire clasp.

If a high-heat chrome alloy is used, the wrought wire has to be soldered to the framework.

1. Wire can be embedded in the resin of the denture base.
2. The wire can be included in the wax-up of the framework and the metal cast to the wire.
3. The wire is contoured after the framework is complete and then attached to the cast clasp by soldering it to the framework.
4. The wrought wire clasp is soldered back on the retentive meshwork, away from the area where it will be required to flex.

Soldering precision attachment

1. A recess is made in the cast larger than the attachment
2. The prosthesis is heated to the solders temperature and the solder is placed onto the prosthesis, which flows into the solder joint gap. Thus the female portion of the precision attachment is soldered.

The repair of broken components

Broken components and reseating components are all aligned properly and soldered with the help of soldering investment indexes.

SUPPORT

Definition

Support is defined as resistance to vertical force directed towards the mucosa.

- During function, force is transmitted through the saddles and to the mucosa and finally to the bone.

- If the denture rests solely on the mucoperiosteum, it is a *mucosa-borne denture*.
- If the denture is supported on adjacent teeth by components such as occlusal rests, it is termed as *tooth-borne denture*.
- In free-end saddle situations it is a *tooth/mucosa-borne denture*.

Planning support

Based on:

1. Abutment teeth,
2. Extent of the saddles,
3. Amount of force on the saddles.

Abutment tooth: If the abutment tooth is strong enough to withstand forces, it can be used to support a prosthesis by occlusal rest and direct retention.

Extent of saddles:

- In small edentulous spaces the tooth itself can withstand stress in large edentulous spaces, as in distal extension bases support is derived from extensive coverage of denture base.
- The design needs to have good indirect retention in distal extension bases to support the prosthesis and prevent rotation of the prosthesis.

Force on the saddles:

- The longer the span the greater are the forces on the saddle.
- Tooth supported dentures are ideal; a mucosa-borne denture is more successful in the upper jaw than in the lower jaw due to palatal coverage.

Components in support

Rests

1. Occlusal rests on premolars and molars.
2. Cingulum rests on upper canines.
3. Incisal rests in lower canines.

Additional functions of rests

1. Distribution of horizontal force.
 2. Providing indirect retention.
 3. Reciprocation.
 4. Maintaining components in their correct position.
 5. Protecting the denture/abutment tooth junction.
 6. Preventing over-eruption.
 7. Improving occlusal contact.
- Direct retainers, Indirect retention, Minor connector and Maximum coverage of denture bases, all directly or indirectly support the prosthesis.

A properly supported prosthesis prevents

1. Vertical displacing forces.
2. Lateral forces.
3. Horizontal anteroposterior forces.
4. Rotational displacement.

If support is absent

1. Results in abutment failure.
2. Excessive bone resorption.
3. Tissue distortion.

IMPORTANCE OF X-RAY IN RPD

Importance of radiographic survey

- Abutment tooth is evaluated.
- Residual ridge is evaluated.
- Other factors as radiolucencies, radiopacities, root tips, impacted tooth, endodontically treated tooth are evaluated.

Errors in X-ray

- The angulation can alter the correct bone height assessment.
- A short cone technique, if used, directs the rays through the root of the tooth at a predetermined angle, hence the chances of elongation errors are more. The true height of

the bone is ordinarily where the lamina shows a marked decrease in opacity.

Radiographic evaluation of abutment teeth

1. Root length, size and form:
 - Teeth with large or long roots are more favourable for abutment teeth. Multi-rooted teeth whose roots are divergent or curved are stronger abutment teeth than single-rooted teeth.
 - Third molars: Unerupted third molars can be considered as future abutments to eliminate the need for a distal extension removable partial denture
2. Crown/Root ratio:
 - A crown/root ratio of at least 1:1 is required for an abutment tooth.
3. Lamina dura:
 - Normally the lamina dura is a continuous radiopaque white line around the radiolucent dark line that represents the periodontal membrane
 - Should be checked for absence, discontinuity, partial loss or thickening of lamina dura.
 - Total absence of the lamina dura may be due to systemic disorders as hyperparathyroidism and Paget's disease.
 - A thickening of the lamina dura can be due to trauma from occlusion.
 - In case of tilting of teeth the lamina dura on the side to which the tooth is sloping becomes uniformly heavier and the bone trabeculations are arranged at right angles to the heavier lamina dura.
 - In case of periodontal problems the lamina dura loses its continuity.
4. Periodontal Ligament Space:
 - A widening of the periodontal ligament space with a thickening of the lamina dura indicates occlusal trauma and heavy function.

- Clinical mobility of the tooth may also be present with the above findings.
To evaluate for zones of attached gingiva:
 - Supporting bone to be evaluated and mobility patterns recorded.
 - Furcation involvements, osseous defects and mobility patterns are to be recorded.
5. Bone index areas: Bone index areas have “a positive bone factor” which includes a supportive trabecular pattern, heavy cortical layer, dense lamina dura, normal bone height and a normal periodontal ligament space.

Quality of bone

1. Normal-sized interdental trabecular spaces decreasing in size as the bone proceeds from the root apex toward the coronal portion.
2. Abnormal stresses create a reduction in the size of the trabecular pattern.
3. An increased thickness of the periodontal space suggests varying degrees of tooth mobility.
4. An irregular inter-crestal bone surface can be due to active bone deterioration.

The quality of the alveolar support of an abutment tooth

1. An abutment tooth needs to withstand greater stress loads such as vertical, horizontal loads and rotational forces.
2. So an abutment tooth should be thoroughly evaluated for the alveolar support that is present and the past reaction of that bone to occlusal stress.

Density of bone

The quality and quantity of the alveolar bone as the height and the quality of the remaining bone is to be evaluated.

Depending on the radiographic evaluations the final design outcome of partial dentures can be decided positively. Abutment tooth and edentulous ridges can be evaluated to confirm if they can withstand the stresses.

COMPARE AND CONTRAST ACRYLIC WITH CAST PARTIAL DENTURE ALLOYS

Acrylic resin

Advantages

1. More esthetic as it simulates the appearance of natural mucosa and gingivae.
2. Easy to construct.
3. Acrylic teeth have more strong attachment to denture base than metal.
4. Repairs and additions can be easily done in acrylic dentures.
5. Light weight.
6. Inert in oral fluids.

Disadvantages

1. Low resistance to fatigue and frequent fractures.
2. Low abrasion resistance.
3. Residual monomer can irritate oral mucosa.
4. Water absorption and shrinkage lead to dimensional changes.
5. Can distort during processing and finishing.
6. Crazeing can occur, weakening acrylic resin.
7. Detection by radiograph is difficult.

Recent improvements

1. High impact polymethyl methacrylates, resins, have better fatigue and impact resistance.
2. Addition of carbon fibres can increase strength and rigidity.
3. Barium sulphate can be added to acrylic to make it radiopaque.

Metal alloys

Commonly used alloys for partial denture:

- Hard gold alloys
- Wrought alloys
- Base metal alloys.

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Gold alloys

Types

- Type IV Yellow gold alloy was the first metal to be used commonly for partial dentures.
- Silver-palladium alloys (White Gold).

Yellow gold

Advantages

1. Accurate final denture if cast into an investment which gives compensatory thermal expansion.
2. Final adjustment of clasp is done while alloy is softened which later can be given hardening heat treatment to increase proportional limit and modulus of elasticity.
3. Components can be easily soldered to the main base.
4. Ease of fabrication.
5. Chemically inert.

Disadvantages

1. Expensive.
2. Strength, hardness and ductility vary.
3. To increase strength bulk has to be increased.

Silver-palladium alloys (White Gold)

Advantages

1. Accurate dentures can be made.
2. Components can be added by soldering.
3. Cheaper than yellow gold.

Disadvantages

1. Tarnish due to the formation of silver sulphide.
2. The alloys are difficult to cast.
3. Dissolution of oxygen produces porosity.
4. The proportional limit and ultimate tensile strength are less than yellow gold alloys.

Wrought alloys: Gold alloys and stainless steel alloys can be swaged between dies and counter dies to design partial dentures

Disadvantages of wrought metal denture bases are

1. The fit is less accurate than with castings.
2. Some designs are difficult to fabricate with wrought alloys.
3. Low strength.
4. Rigid components are to be welded and soldered to the main framework.

Base metal alloys:

Types:

- Cobalt-chromium alloys
- Nickel- chromium alloys

Constituents

1. Cobalt and chromium: 60% and 30%.
2. Molybdenum: 5%
3. Carbon: 0.2%
4. Traces of Molybdenum, Tungsten, Manganese, Silicon and Aluminium are present to improve the physical properties of alloys.
 - Chromium content makes the alloy corrosion resistant.
 - Cobalt gives alloy its strength and hardness.
 - Nickel reduces the tensile strength but increases the ductility of the alloy.
 - Molybdenum: Prevents intra-granular corrosion and surface pitting.
 - Carbon: As chromium carbide improves strength up to 0.2%.
 - Manganese: Acts as a flux and scavenger and increases the fluidity and 'castability'.
 - Silicon: Makes denser casting and also increases fluidity and 'castability'.
 - Aluminium: Increases the ultimate tensile strength and yield strength of the alloy.

Advantages

1. Due to their superior physical properties thin section can be used.
2. High resistance to fatigue
3. Their thermal conductivity enables to appreciate heat and cold sensations.

Disadvantages of metals

1. Difficult to fabricate.
2. Not aesthetic.
3. Relining and rebasing cannot be done.
4. Not orally inert as gold alloys.
5. Electrolytic action can occur if in contact with dissimilar metal filling.

IMPRESSION MATERIALS USED IN RPD**Impression materials used**

1. Irreversible hydrocolloid.
2. Reversible hydrocolloid.
3. Polysulfide rubber.
4. Silicone rubber.

Irreversible Hydrocolloid (Alginate)*Advantages*

1. Ease of handling.
2. Inexpensive.
3. Custom-made tray is not required for impression.
4. Dimensional accurate.
5. Lack of additional items of equipment.
6. Cleanliness of the material.

Disadvantages

1. Inability to store safely.
2. The impression must be poured immediately within 12 minutes.

Impression technique

Tray selection and extension:

1. A rim-locked perforated tray has to be selected for alginate impression.
2. The tray has to be adequately extended along the borders and the palatal portion can be modified if the palatal vault is high using a modelling plastic.
3. For the lower trays lingual extension, wax can be used to extend tray to adequate depth. Using wax is not an accurate method. Correct peripheral extension can be obtained by good impression technique.
4. Alginate is the commonest material preferred for single pressure free impressions.

Impression

1. Prepare the mouth by having the patient rinse.
2. Measure and mix the impression material according to directions and load the tray.
3. Seat the tray, clear the lips and cheeks.
4. For the mandibular impression patient's tongue is raised and protruded gently.
5. Hold the tray steady until the material has set.
6. Remove the tray with a sudden movement in a direction parallel to the long axis of the teeth.
7. Wash and clean saliva from the impression.
8. Disinfect the impression.

Reversible hydrocolloid (Agar-Agar)

It was the first elastic impression material to be used in dentistry.

Advantages

1. More accurate than alginate.
2. Cleanest elastic material.

Disadvantages

1. Additional equipment is required for its use.
2. More expensive than alginate.

Availability

- The tray material is supplied as a gel in a collapsible tube.
- The lighter injectable material is supplied in a small collapsible tube for injection.

Composition

- Tray material consists of 15% agar, 0.2% borax for strength, 0.1% benzoates as preservatives and 1% to 2% potassium sulphate to obtain surface hardness of the master cast. Water content is between 80% and 85%.
- Syringe materials consist of lower agar content, 6% to 8%. The rest of the composition is same as for tray material.

Clinical use: Most units consist of three controlled temperature water baths for:

1. Liquefying the material at 100°C for 15 minutes.
2. Storing to maintain the liquid phase and this is done at 60°C.
3. Tempering /conditioning bath at 45°C. The loaded tray is left in the tempering bath for 5 minutes.

For injectable hydrocolloid tempering bath is not used. When the injection material is needed, it is taken from the storage bath and used immediately.

Special water-cooled impression tray with hoses connected to the entry and exit tubes is used to cool the entire impression in the oral cavity before its removal. For cooling water of 21° to 22°C is preferred.

Procedure

1. The light material is first placed in crucial areas requiring minute details to be registered and this is followed by the tray impression.
2. The areas requiring exact duplication is copied by light injectable material and the rest of the areas are copied by the tray material.
3. The impression is removed from the mouth with a single quick definite movement to prevent tearing or distorting the material.

4. After the impression is poured with a minimal expansion dental stone, the cast should be separated within 45 to 60 minutes after the initial set of the stone.

Polysulfide Rubber

The first rubber impression material was known as Thiokol.

Availability: Supplied as two tubes of paste.

Types

1. **Light:**
Used in a syringe for injection purposes or in complete dentures.
2. **Regular:**
Used in combination with light body for removable prosthodontics.
3. **Heavy-bodied:**
Is used in combination with the light-bodied injection material.

Composition

- One tube contains base,
- Other tube contains catalyst.

Base paste tube consists of

Eighty percent low-molecular-weight organic polymer containing mercaptan groups and 20% reinforcing agents.

Catalyst tube contains

Activator—Lead dioxide or other activators such as t-butylhydro-peroxide activates the mercaptan groups to react and form the polysulfide rubber.

Clinical use

1. Equal lengths of the base and catalyst are extruded and mixed with a stiff spatula on a paper mixing pad.

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2. If an injection with light-bodied material is to be made, the two mixes are started at the same time. The mixing is accomplished with a circular sweeping motion.
3. Mixing is completed when there is uniformity of the colour and within 45 seconds.

Impression

1. The injection material is loaded into the syringe and the tray material into the custom tray immediately.
2. The injection material is deposited into rest seat preparations and other critical areas with the syringe to avoid trapping air.
3. The loaded tray is seated, held steadily until the final set occurs approximately within 8 minutes.

Advantage: Accurate and more dimensionally stable than hydrocolloids.

Disadvantages

1. Cannot be used in severe undercuts, as the material is not elastic.
2. Tooth breakage while removing the cast is also common.
3. Offensive odour and colour.
4. Staining of clothing.

Silicone Rubber

Types: Light, regular, heavy-bodied and putty.

Composition

Base paste: Contains a low-molecular-weight silicone liquid, dimethylsiloxane and Silica— 35% to 40%, in putty — 75%.

Catalyst paste: Contains tin octoate suspension and an alkyl silicate with addition of thickening agents.

Clinical use: Manipulation same as for polysulfide rubber. The mixing is continued until the material is free of streaks, normally 45 seconds.

Advantages:

1. No odour, or staining as in polysulfide.
2. More dimensionally stable than polysulfide.
3. Elastic can be used in moderate undercuts.
4. Cast can be poured after some time.
5. Impression can be preserved if required.

Disadvantage: For accurate impressions a custom tray need to be used.

DIFFERENCES BETWEEN TOOTH SUPPORTED AND TOOTH-TISSUE SUPPORTED DENTURE

1. A tooth-borne denture can withstand loads nearly equal to loads on the natural teeth.
2. A tooth-borne denture imposes a greater load on the opposing teeth than mucosa-borne denture.
The load on the mucosa is restricted by the pain threshold of the mucosa compressed.
3. Occlusal rests prepared on a mucosa borne tend to absorb greater loads than a tooth borne.
Hence, to withstand these additional loads and prevent rotation of mucosa-borne dentures, indirect retention is required.
4. Premolar and molar teeth are ideal rest seats. If a canine or incisor tooth is to be prepared for rest, in some cases, restorations need to be placed to resist vertical load.
5. Canines and incisors can be used in resisting vertical loads, if taken together as a group of three or more teeth.
6. Mucosa borne dentures need extensive coverage in order to distribute uniform forces as compared to rest seats alone.
7. A mucosa-borne upper denture resists vertical loads better as it covers the hard palate. A mucosa-borne upper denture opposing a mucosa-borne lower denture, need to cover only the area covered by the sum of the lower saddles.

8. The larger the area covered by a mucosa-borne denture, the less the load per unit area.
9. In mucosa borne dentures the shape of the tooth selected needs to be narrow buccolingually.
The less the buccolingual dimension, the less will be the occlusal load that is transmitted.
10. The number of teeth selected to replace can also be reduced if the opposing tooth is not present in mucosa borne dentures. All the above factors reduce the stress to be borne by the mucosa and the abutment tooth.
Stress equalizers can be used in mucosa borne dentures to equalize the forces between the tooth and mucosa.
11. The tooth borne situations need only a single pressure free impression, whereas a mucosa borne situation needs a dual impression to record the edentulous ridge in their functional form and tooth in their anatomic form.
12. The mucosa borne situations are best made of a material which can be relined or rebased in future. A tooth borne situation can be made of a metal denture, as relining chances are less.
13. All mucosa-borne situations are found to cause:
 - a. Residual ridge resorption.
 - b. Abutment tooth failures in the long run.
 - c. Ill fitting prosthesis.
 - d. Fracture of components.
 - e. Unseating of rest seats.

BLATTERFEIN'S DESIGNING OF MAJOR CONNECTOR

Blatterfein in 1953 described a systematic approach to design maxillary major connectors.

Factors important for designing

1. Diagnostic cast.
2. Knowledge about the displaceability of the tissues.
3. More applicable to maxillary partial denture situations.

Design consists of five steps

1. ***Outline the primary bearing areas*** that will be covered by the denture base.
2. ***Outline the non-bearing areas*** as the lingual gingival tissues within 5 to 6 mm of the remaining teeth, hard areas of the medial palatal raphe and palatal tissues posterior to the vibrating line.
3. ***Outline the strap areas.***
4. Selection of strap type:

The type of strap is dependent on:

- a. Comfort.
- b. Rigidity.
- c. Location of denture bases.
- d. Indirect retention.

Rules for placement of connecting straps

- a. Should be of minimum bulk.
- b. Should not interfere with the tongue position during speech and mastication.
- c. Should be rigid to distribute stress bilaterally.
- d. The strap selection depends on the edentulous span, tori and any prominent undercuts.
- e. Depending on tooth borne situation or mucosa borne situation the design of major connector differs.
- f. In mucosa borne situation indirect retention is required and provision must be made in its location to attach indirect retainers.
- g. The most ideal type of major connector for upper arch in mucosa borne denture is the complete palatal coverage and for lower is lingual plate.
- h. In tooth borne situations depending on the edentulous span and patient comfort any type of major connector can be used. Lingual bar for lower and palatal bar are the least used.

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Unification: After selection of the type of major connector the denture base areas and connecting straps are joined.

Beading of the maxillary cast

Beading is done by scribing a shallow groove on the maxillary master cast that outlines the borders of the major connector in contact with the tissues except the rugae areas.

Importance of beading

1. For transferring the major connector design to the investment cast.
2. To provide a visible finishing line for the casting.
3. To ensure intimate tissue contact of the major connector with the tissue.
4. Beading helps to maintain contact with tissue and prevents food entrapment and ensures cleanliness.

DIFFERENCES BETWEEN NEY AND JELENCO SURVEYORS

Definition

A Surveyor is a parallelometer, an instrument used to determine the relative parallelism of surfaces of teeth or other areas on a cast of the jaws.

Ney and Jelenco are surveyors used to locate path of placement, height of contour and retentive under cuts for clasps.

- The first surveyor appeared in 1918 and was designed by Dr. A.J. Fortunati.
- The first commercially available surveyor was Ney surveyor in 1923.

Differences between Ney and Jelenco

Horizontal arm: Jelenco surveyor was designed by Dr. Noble Wills, also known as Wills surveyor.

- In Jelenco surveyor the horizontal arm may be made to swivel by loosening the nut at the top of the vertical arm.

- In Ney surveyor the horizontal arm is fixed and surveying depends on the horizontal movement of the cast.

Objective of horizontal arm movement

- Helps freedom of movement in a horizontal plane rather than depending on the horizontal movement of the cast.
- The surveying can also be carried out by moving the cast only in a horizontal relationship to a fixed vertical arm, with the horizontal arm in a fixed position.

Vertical arm attachment

- In Ney surveyor the vertical arm is retained by friction within a fixed bearing.
The shaft can be moved up or down and fixed at any position required by the help of tightening a set screw.
- The vertical arm of the Jelenco surveyor is spring mounted and returns to the top position when released.

Disadvantages

- a. Needs to be held down against spring tension while in use.
- b. Even if the spring is removed, the friction of the two bearings supporting the arm does not hold it in the same position as in Ney surveyor.

Uses

- As the shaft on the Ney surveyor is stable in any vertical position, a drill press with a handpiece holder can be added.

Advantages

- a. The handpiece can be used to cut recesses in cast restorations with precision.
 - b. Parallel placement of grooves and other procedures requiring precision in cast restoration can be carried out by using burs or carborundum points of various sizes.
- This use is not possible with Jelenco surveyor.

Surveying technique: The surveying technique varies slightly for each.

- The Ney surveyor depends entirely on cast movement in horizontal plane to locate undercuts, path of insertion and height of contour.
- The Jelenco surveyor can utilise the horizontal arm movement and cast movement to locate appropriate path of insertion.

The principal parts of the Jelenco surveyor and Ney surveyor are the same

1. Platform on which the cast holder is moved.
2. Vertical arm that supports the superstructure.
3. Horizontal arm from which the surveying tool suspends.
4. Surveying arm to which the special tools are attached.
5. Table to which the cast is attached (Cast holder or Surveying table which permits movement in horizontal planes by Ball and socket action).
6. Mandrel for holding special tools.

KENNEDY CLASS IV ARCHES

Class IV is an anterior edentulous area. In designing Class IV partial dentures aesthetics is an important factor.

Principles for Class IV removable partial dentures

The principle for designing Class IV removable partial dentures is based on broad stress distribution philosophy.

1. The fulcrum line and the movement taking place around it is reversed, compared to Classes I and II arches.
Hence, the teeth adjacent to the edentulous space are taken for direct retention after locating the retentive area. Preferably the mesiobuccal surface of anterior teeth is selected for the retentive undercut.
2. In Class IV the indirect retainer is placed on each side of the arch posteriorly, engaging a distobuccal retentive undercut.
3. There are no modification spaces for Class IV removable partial dentures.

Design aspects

It is a quadrilateral design.

Major connector

1. For upper is complete coverage and for lower is lingual plate.
2. The major connector should be supported by positive rest seats.

Direct retention

1. Direct retainer is placed on the mesiobuccal surface of anterior teeth adjacent to the edentulous space.
2. If canine is present, I-bar can be used as a direct retainer of choice in case of distobuccal under cut.
3. If premolars are present mesiobuccal retentive undercut is utilised to place a circumferential clasp.

Rest seats

1. If canine is present, cingulum rest seat is prepared on canines on each side.
2. If premolars are the tooth adjacent to the edentulous area, then occlusal rest seats are prepared on both side premolars.
3. Auxiliary rest seats are also prepared for the posterior most teeth on either side of the arch for indirect retention.

Indirect retention

Is placed on each side of the arch posteriorly, engaging a distobuccal retentive undercut.

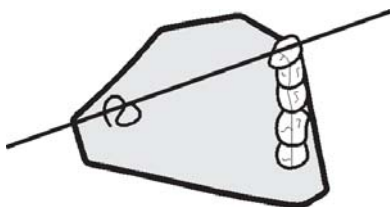


Figure 62: Fulcrum line for class iv design

Minor connectors

1. Connecting the direct retainers placed anteriorly to major connector.
2. Connecting indirect retainers to major connector.
3. Connecting anterior denture base to major connector.
4. In case I-bar is used as direct retainer, the approach arm minor connector is also present.

Occlusion

1. Centric occlusion and centric relation should coincide.
2. A harmonious occlusion should be established with no interceptive contacts and with all eccentric movements dictated by, or in harmony with, the remaining natural teeth.
3. The vertical overjet and overbite should be evaluated.

Artificial teeth

1. Should be selected and positioned depending on aesthetics, smile line and space available for replacement of artificial tooth.
2. The artificial tooth should be placed as possible in the previous natural tooth position.

Denture base

1. The base should be designed with broad coverage with labial flange or without depending on the clinical situation.
2. The extension of the borders must not interfere with functional movements.
3. The polished surfaces should be contoured for maximum neuromuscular control.

POSSIBLE MOVEMENTS OF PARTIAL DENTURE

Three possible movements of a distal extension partial denture exist

1. Rotation about an axis through the most posterior abutments.

2. Rotation about a longitudinal axis.
3. Rotation about an imaginary vertical axis.

Rotation about an axis through the most posterior abutments

- This rotation occurs around the fulcrum line, a line crossing the posterior most abutment tooth from one side of the arch to opposite side of the arch.
- Occurs when an occlusal load is applied and when the distal extension base moves toward the supporting tissues.
- Movement occurs through an occlusal rests or through rigid portion of a direct retainer located occlusally or incisally to the height of contour of the abutments.

The forces causing this movement are:

- a. Vertical pull of food between opposing tooth surfaces.
- b. Effect of moving border tissues.
- c. Forces of gravity against a maxillary denture.

Depends on: The total amount of occlusal load applied.

Rotational forces are resisted by:

- a. Tissues of the residual ridge.
- b. Extensive denture base coverage.
- c. Accuracy of denture base fit.

Components resisting it:

1. Retentive clasp arms on terminal abutments along with rests.
2. Support elements anterior to the terminal abutments acting as indirect retainers.
3. In a tooth-borne partial denture these forces are resisted by:
 - Rests on the abutment teeth
 - Rigid portion of the framework located occlusal to the height of contour.
 - Direct retainers on the abutments.

Rotation about a longitudinal axis

This occurs when a distal extension base moves in a rotary direction about the residual ridge.

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Components resisting it: Rigidity of the major connector and its ability to resist torque.

Occurs when:

- a. Stress breakers are present the rotation about a longitudinal axis causes stress to the sides of the supporting ridge or cause horizontal shifting of the denture base.
- b. Denture base coverage is minimum.
In tooth borne abutments these movements are less due to the presence of posterior abutments.

Resisted by:

1. Rigid components of the direct retainers on the abutment teeth.
2. Ability of the major connector to resist torque.

Rotation about an imaginary vertical axis

This is located near the centre of the dental arch.

Occurs: When diagonal and horizontal occlusal forces are applied on the partial denture.

Resisted by: Stabilizing components such as reciprocal clasp arms and minor connectors that contact the vertical tooth surfaces.

Mode of action: Stabilizing components acts on one side of the arch by resisting horizontal forces applied from the opposite side.

Forces are caused by:

1. Failure to orient the occlusal plane.
2. Uncorrected malpositioned teeth.
3. Effect of abnormal jaw relationships.
4. During mastication and bruxism.

Can be reduced by:

1. Creating an occlusion that is in harmony with the opposing dentition with no lateral interference.
2. This movement occurs in all types of partial denture therefore stabilizing components must be incorporated in the design.

Occlusal rest

- Functions of occlusal rest are not directly involved in rotation about a longitudinal axis and rotation about an imaginary vertical axis.
- As these three movements occur in partial dentures, the occlusal rest should not have steep vertical walls or locking dovetails.
- If present, could cause horizontal and torquing forces to be applied to the abutment tooth.

Tooth borne denture

- Only movements of significance are horizontal and these are resisted by the stabilizing effect of components placed on the axial surfaces of the several abutments.
- In tooth-borne denture the use of intracoronal rests is permissible. These rests provide occlusal support and horizontal stabilization to some extent.

Distal extension denture bases

A ball-and-socket type of rest or the non-locking internal rest is preferable.

RELINING**Definition**

Relining is the process of adding some material to the tissue side of a denture to fill the space between the tissue and the denture base.

Indications for relining

1. Immediate dentures after three to six months when the extraction sockets have healed and remodelled.
2. Extensive ridge resorption with loose fitting denture especially when patient is happy with esthetic aspect.
3. Poor patients who cannot afford the cost of having new dentures constructed.
4. Geriatric or chronically ill patients.

Requirements for a denture to be relined

1. Healthy oral tissue.
2. Correct occlusal vertical dimension.
3. Centric occlusion should coincide with centric relation.
4. Adequate interocclusal distance.
5. Satisfactory aesthetics (The size, shape, shade and arrangement of the artificial teeth must be satisfactory).
6. Coverage of denture bases should be adequate.
7. The denture base extensions are adequate, hence distributing even masticatory forces over a large area as possible.
8. Satisfactory speech.

Contraindications

1. When centric relation record is not accurate.
2. When interocclusal distance is not proper.
3. Excessive bone resorption.
4. When abused soft tissues are present.
5. When the patient complains of temporomandibular joint problems.
6. When the denture base is under extended.
7. Poor aesthetics
8. Major speech problem.
9. In severe osseous undercut.

Relining techniques

There are two major relining techniques:

- Open-mouth technique,
- Closed-mouth technique.

In an open-mouth technique major emphasis is given to making separate impressions, with independent attention given to recording jaw relations.

In a closed-mouth relining technique a habitual centric occlusion is usually accepted. This centric occlusion may or may not be the same as centric relation.

Tissue Preparation

1. Excessive hypertrophic tissue should be surgically removed. The dentures can be used as a surgical splint.
2. The oral mucosa should be free of areas of irritation.
3. Removal of the dentures from the mouth during sleep is a must for several weeks before treatment commences.
4. The dentures should be left out of the mouth at least two to three days before making the final impression.
5. Daily massage of the soft tissues is helpful to stimulate their blood supply.

Denture preparation

1. Pressure areas on the tissue surface of the dentures should be relieved.
2. Minor occlusal disharmony is corrected by selective grinding.
3. Small border inadequacies are corrected.
4. A correct posterior palatal seal area should be established before the final impression. Stick compound and autopolymerizing acrylic resin can be used for this purpose.

Principal pitfalls: The principal pitfalls that must be avoided in any technique to refit a complete denture are as follows:

1. Do not increase the occlusal vertical dimension.
2. Multiple even contacts (maximum inter-cuspal contact) should be present in centric relation.
3. Do not permit the maxillary denture to move forward during impression making.
4. Ensure that centric relation and centric occlusion are identical.
5. Ensure that an accurate posterior palatal seal has been established.
6. An equal thickness of final impression material should be used.

Chairside technique

Both the static technique and the functional impression technique are good techniques in cases for simple situations and complicated situations as excessive tissue changes. Chairside technique is not used commonly due to chemical burn on the mucosa, a bad odour, lack of colour stability of the lined acrylic and the difficulty of removing the material if the denture was not positioned correctly.

Use of Visible light-cured (VLC) resin systems as substitutes to the liner is a better choice of material than acrylic because of its many advantages.

Advantages of VLC resin systems are good fit, strength, ability to polymerise without residual components, ease of fabrication and manipulation, patient acceptance, ability to bond with other denture base resins and low bacterial adherence.

REBASING

Rebasing is a process of refitting a denture by the replacement of the denture base material.

The purpose of such a process is to fill the space between the tissue and the denture base without changing the position of the teeth and the relation of the dentures.

Indications

1. Underextended denture with no retention.
2. Ill fitting denture.
3. Fractured denture
4. Stained denture.

Rebasing technique

1. Tissue surface is relieved along with the borders for border moulding and final impression procedures.
2. After border moulding and final impression, a cast is poured.

3. The cast and denture are mounted on Hooper's duplicator or a jig can be used.
4. A plaster index of the teeth is made.
5. The denture base is trimmed with only 2 to 3 mm of resin material around the teeth.
6. The teeth are then set into the key index.
7. The trimmed denture base is re-contoured using base plate wax with the teeth contacting the key index.
8. The re-contoured denture base is flaked.
9. Acrylization and processing of the rebased denture is carried out.
10. The rebased denture is finished and polished.

TOOTH REPLACEMENTS

Tooth replacements are of two types

1. Anterior tooth replacements,
2. Posterior tooth replacements.

Anterior tooth replacements

Single tooth replacement, is normally accomplished with a fixed partial denture.

In certain cases removable partial denture need to be used as:

1. In young patients as an interim prosthesis.
2. Poor general health.
3. When periodontal support of the abutment teeth is weak.
4. When the edentulous span is too long.
5. In case of excessive loss of the edentulous ridge.

Types of anterior tooth replacements:

1. Porcelain denture teeth on denture base.
2. Plastic denture teeth on denture base.
3. Facings.
4. Tube teeth.
5. Reinforced acrylic pontics (RAPS).

Porcelain teeth

Advantages

1. Aesthetic.
2. Hardness and resistance to abrasion is good (This maintains proper vertical dimension of occlusion).

Disadvantages

1. Unglazed porcelain teeth, which oppose natural teeth, can wear the enamel surfaces of natural teeth rapidly.
2. Porcelain fractures easily by impact stresses.
3. Cannot be used in cases of decreased interarch space.
4. Difficult to use for single tooth replacement.
5. Requires bulk for adequate strength.
6. Requires mechanical retention with denture base in form of nail head, spurs or loop.

Uses

Porcelain teeth should be used when removable partial denture opposes a complete denture and where adequate interarch space is present.

Plastic teeth

Advantages

1. Very high impact strength.
2. Chances of fracture and breakage are less frequent.
3. Can be ground and reshaped to fit available space without losing its strength.
4. Aesthetic.
5. Permits wider distribution of vertical forces.
6. Restores lost portion of edentulous ridge.
7. Easy to repair and reline denture.
8. Chemical bond to denture base.

Disadvantage

Lack of resistance to wear and abrasion.

Facings

Advantages

1. Adequate strength.
2. Can be placed in restricted spaces.
3. Convenient as prefabricated in laboratory.
4. Interchangeable facings can be easily replaced.

Disadvantages

1. Not aesthetic.
2. As the lingual half of the facings is metal, the metal influences the shade of the plastic or porcelain facing.
3. Cannot be used in cases of deep vertical overbite.
4. Can be used only in broad well-healed ridges.
5. No freedom of position.
6. Cannot be relined.
7. Cannot be used on resorbed ridge.
8. No support is derived from the underlying ridge.

Uses

1. Can be used as a single tooth replacement in case of limited interocclusal space.
2. Can be used in a broad, well-healed ridge with little resorption.

Tube teeth: Are artificial teeth with an internal, vertical, cylindrical aperture extending from the centre of the base upward into the body of the tooth, into which a pin may be placed or cast for the attachment of the tooth to a denture.

Procedure

1. The tube tooth consists of a plastic or porcelain denture tooth on which a channel or tube is drilled from the base of the tooth upward.
2. During the waxing of framework, the tooth is positioned and connected to the framework by waxing the prepared tube to the rest of the denture.

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3. Before investing, the artificial tooth is removed and only the wax post is left to be cast.
4. After the framework has been finished and polished, the tooth is cemented on the post.

Advantages

1. Good aesthetic replacement for a single tooth if space is available, particularly in the premolar area.
2. Opposing teeth will occlude against the acrylic resin tooth.
3. No need for investing and processing the denture after the framework is finished.

Disadvantages

1. Needs space mesiodistally and occluso-lingually.
2. Requires well-healed, non-resorbed ridges.
3. Derives no support from the soft tissue.
4. Cannot be relined.

Reinforced acrylic pontics (RAPs): The RAP combines the good aspects of facings and tube teeth and eliminates many of their limitations.

The gingival half of the lingual surface consists of projections or loops of metal, around which the artificial tooth is processed.

The incisal half is plastic, which provides easy shade control.

The RAP is used only for anterior teeth and maxillary first premolars.

Advantages

1. Good strength and aesthetics.
2. Occlusion is confined to the plastic.
3. Can be used in a restricted space.

Limitations

1. Cannot be used in resorbed ridges.
2. No support from the ridge.
3. Cannot be relined.

Posterior tooth replacements

Types of posterior tooth replacements:

1. Plastic teeth.
2. Porcelain teeth.
3. Metal pontics.
4. Metal pontics with acrylic windows.
5. Tube teeth.

Plastic teeth:

Disadvantages:

1. Wear and abrasion of plastic teeth.
2. Can alter the vertical dimension of occlusion and changes the occlusal relationship of occlusal surfaces.
3. Strict recall program is essential.
4. Once the tooth flattens more stress is transmitted to the ridge leading to resorption.
5. Cutting efficiency is reduced over a period of time.

Porcelain teeth: Porcelain teeth should be used only when artificial teeth are opposed by artificial teeth or can cause wear of the natural teeth.

Metal Pontics

Indication:

Where the interarch space is severely restricted.

Gold or chrome alloy can be used.

Ideal material of choice is gold

Modifications

As the chrome alloy teeth contact opposing natural teeth, they can cause wear of the natural teeth. To prevent this, occlusal surfaces can be processed in tooth-coloured resin and attached to the metal tooth.

Metal Pontics with acrylic windows: When aesthetics are of concern with less space, the buccal surface of the pontic is cut

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away during framework wax-up and tooth-coloured resin processed in the recess.

Tube teeth: Tube teeth are the most used form of posterior tooth replacement next to denture teeth.

Disadvantages

1. Limited to one, two, or three teeth replacement and should be tooth supported.
2. Cannot be used for a distal extension ridge.
3. The ridge should be well-healed.
4. Relining cannot be done.

FIXED REMOVABLE PARTIAL DENTURES

This term denotes the concept of removable pontic sections supported by abutment teeth.

The first removable partial denture was a round bar attached to abutment crowns that supported a suprastructure designed by Fossum.

Types

Bar and clip with extended tissue coverage by Dolder, Baker and Hader and Andrews.

Bar and sleeve devised by Bennett is called Bennett Blade.

Parts

1. Milled substructure bar.
2. Suprastructure.
3. Spring wire pins.

Indications

- a. Osseous deformities.
- b. Trauma.
- c. Natural resorption.

Steps in locating the placement of each component

1. Initially, path of placement is determined.
2. Teeth are selected and tried to the edentulous area of the diagnostic cast.
3. This provides a guide to the placement of substructure bar. The bar is placed lingual to these teeth.
4. Positioning of retentive pins: After orienting replacement teeth, they are stabilised with a removable plaster core. The ideal pin location is opposite the interproximal spaces of adjacent replacement tooth.
5. After pin positioning, 0.7 mm size drills are used and drilled into respective ridge areas of the working cast to a 2 mm depth.

Fabrication of the substructure bar

1. Substructure bar is developed in wax around the pre-positioned stainless steel pins.
2. The bar is carved to its correct dimensions and its sides are made parallel to each other.
3. The wax bar is removed and cast in Type IV gold alloy with the pins in place.
4. After casting, the bar is reoriented into the path of placement and joined to abutment by soldering.
5. After assembling bar to abutment the parallel pins are removed and replaced by carbon rods.
6. The assembled substructure is placed back on cast, which is placed on the milling machine for refining lateral surfaces.

Fabrication of suprastructure

1. The stainless steel pins are placed back in substructure.
2. The plaster core is repositioned and pattern resin is placed on the lubricated substructure.
3. The pattern resin or wax is added till the desired contour is obtained.

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4. Retentive elements, such as loops or bars, are placed on the facial aspect of the suprastructure pattern to provide retention for artificial tooth.
5. The suprastructure pattern is removed and cast in Type IV gold alloy.
6. The retentive pins are replaced with metal pins and these are soldered to the suprastructure.

Advantages

1. Flexibility of design
2. Can maintain good oral hygiene as the prosthesis can be removed.
3. Minimal tissue coverage.
4. Aesthetic.
5. Ease of adjustment.

Disadvantages

1. Abutment requirements as for fixed partial denture.
2. Abutment tooth have to be splinted together for common path of insertion.
3. Require more occlusogingival clearance (E.g. 3 to 4 mm).
4. Can have gingival irritation if oral hygiene is not maintained.
5. Precise technical procedure is required.

CASTING

Definition

Casting is the formation of an object by the solidification of a fluid that has been poured or injected into a mould.

Steps in casting

1. Fabrication of wax pattern.
2. Spruing the wax pattern.
3. Attaching the wax pattern to crucible former.
4. Investing the wax pattern in a casting ring.

5. Burn out.
6. Melting the alloy.
7. Casting the alloy.
8. Recovering the cast.
9. Finishing and polishing the cast.

Spruing

Sprue directs the flow of molten metal. It has a 'sprue former' (from where the cast metal flows in) and a reservoir placed 1 mm away from the pattern, along the path of sprue. This acts as a storage mechanism for molten metal.

Types

- a. Single sprue.
- b. Multiple sprues.

Placing sprues

In RPD, a sprue hole is made on the cast in the centre through which the sprue enters.

The rest of the framework can be attached to this by a single sprue or multiple sprues.



Figure 63: Main sprue for cast partial dentures

Investing

1. An appropriate sized casting ring is selected.
2. A layer of dry cellulose liner is placed inside the ring and the ring is immersed in a bowl of water to moisten the liner.
3. The casting ring is assembled with a crucible former with the wax patterns attached to it.

4. The investment material is mechanically mixed by spatulation under a vacuum approximately for 15 seconds.
5. Gently, the investment material is brushed on to the wax pattern with a small brush.
6. The ring is fused with crucible former with sticky wax.
7. The investment is slowly poured down on one side of the ring with vibration.
8. Once the pattern is covered the ring is filled with the rest of the investment material with a minimum of vibration.
9. There should be an excess of investment above the end of the ring so that the hardened glaze can be easily ground away on a model trimmer.
10. The investment takes 60 minutes to reach its final set.

Burn out is done to:

- a. Dry the mould (100°C for 1 hour).
- b. Expand the mould to compensate for metal shrinkage. (538°C for 1 hour)
- c. To eliminate the wax pattern (600 to 710°C for 1 to 2 hours).

Types of casting machines

1. Air pressure casting machine.
2. Centrifugal casting machine.
3. Electrical resistance casting machine/Induction casting.

Casting technique

1. Casting ring is placed and locked in position in the induction casting machine.
2. The required amount of metal is placed in the crucible in front of the sprue way of the casting ring.
3. Once the metal pellets are heated by induction to sufficient consistency, which can be viewed through the viewing glass, the casting machine is released by unlocking the spring.
4. Casting is completed by centrifugal technique.

Recovering the casting

- After cooling for 12 minutes and quenching in water, the investment material can be removed by gentle tapping.
- The investment adhering to the casting is removed by sand blasting.

Finishing and polishing

Sprues are cut using carborundum discs.

Finishing burs are used to smoothen small irregularities and polishing is done by using rouge on the polishing buff.

POST INSERTION OBSERVATION

The patient should be seen within 24 hours after the insertion of any removable prosthesis.

Complaints fall into three main categories

1. Relating to soft tissues.
2. Relating to tooth.
3. Miscellaneous Complaints.

Relating to soft tissues

1. Irritation.
2. Laceration.
3. Ulceration.

Factors causing soft tissue irritation/redness:

Overextended denture base

Areas with increased redness or translucency with or without pain should be corrected.

Methods of evaluating

- a. By asking the patient to do functional movements.
- b. By use of disclosing wax.
- c. By marking the area with indelible pencil and transferring the mark to the denture.

Locating overextension

- a. The prosthesis is placed and cheek is manipulated downward, outward, upward and in the anteroposterior direction. In case of overextension, movement of the border tissue is impeded or the prosthesis lifts from its basal seat.
- b. If on the lingual aspect of the mandibular edentulous ridge, the patient is asked to thrust tongue forward and touch the tongue on the cheek opposite the side being examined.

Indelible pencil method

- a. The area of soft tissue is dried and marked with the indelible pencil.
- b. The prosthesis is placed in position and the border tissues movements are done.
- c. The area requiring relief will be copied on to the denture.

Correcting overextension

- a. A vulcanite bur or an arbor band is used to correct the areas.
- b. The corrected flange must be rounded and smoothened.
- c. After correcting the overextension, patient should be instructed to use hot saline mouthwash every 4 hours.

Rough tissue surface of the denture base

- a. A pressure-indicating paste is used to locate the area of roughness.
- b. The located area is relieved using acrylic resin cutting stone or bur if the denture base is made of acrylic resin.
- c. After the correction the denture base is felt with the tip of a finger over the tissue surface.

Occlusal discrepancies or prematurities

The occlusion has to be evaluated and if occlusal discrepancies are present, denture is remounted with the aid of check records and selective grinding is carried out.

Relating to tooth

Soreness of a tooth/group of teeth:

1. Lateral pressure from the metal or resin of the prosthesis:
 - a. Restoration of tooth should be evaluated.
 - b. The prosthesis is removed and mesial, distal, buccal and lingual pressure is applied to each tooth by using fingers.
 - c. If the tooth was subjected to undesirable forces, a painful response to finger pressure is elicited.
 - d. Using a disclosing wax will help in locating the area of metal or resin that requires relieving to prevent this tooth movement.
 - e. Carbide burs in the high-speed handpiece are used, to correct these areas of show-through.
2. Occlusal stress:

If there is no area of show-through in the disclosing wax, then the next common cause is occlusal interference between a natural tooth in one arch and the metal of the denture in the opposite arch.

Locating the occlusal interference

- a. An articulating paper or occlusal indicator wax strips is used.
- b. The patient is instructed to tap the teeth together firmly with the paper or wax in position.
- c. In case of articulating paper, the paper colour will be transferred to the denture where the interference is occurring.
- d. With wax strips, the offending cusp tip will penetrate the wax at the point of interference.

Correcting interference

- a. Heatless stones or carbide burs in the high-speed handpiece are used to correct the occlusal prematurities.
- b. The correction is done outside the mouth by remounting the denture.

Miscellaneous complaints

Gagging

Causes:

Failure of the maxillary major connector to adapt closely to the hard palate.

This can occur due to the slumping of impression material before the final set occurs.

Correction

- a. If the major connector is of acrylic resin relining can be done.
- b. If it is of cast metal, remaking needs to be done.

Posterior overextension of the major connector

- An indelible pencil mark is made along the posterior border of the partial denture.
- The marked denture is seated and removed from the mouth.
- The indelible ink is transferred to the soft tissue of the palate and the overextension is evaluated.

Correction

By trimming the major connector or remaking the denture.

Increased length and bulk of the mandibular denture base flanges.

The flanges are thinned and shortened.

Problems with phonetics

Causes:

1. Position of maxillary anterior teeth.
2. Contour of the maxillary major connector over the rugal area.
3. If maxillary or mandibular teeth are positioned too far lingually.
4. Reading aloud is one of the best methods of adapting.

Correction

After giving adequate time to adapt, if the same problem persists, repositioning of the anterior teeth or altering the contour of the palatal major connector need to be done.

Cheek biting

Causes

1. When maxillary and mandibular posterior teeth are positioned with insufficient horizontal overlap.
2. When teeth are set too far facially to the edentulous ridge.
3. When the natural posterior teeth have been missing for a long period, the buccinator sags into the space created by the missing teeth.

Correction

Corrected by either resetting the teeth or reducing the height of the mandibular buccal cusps by selective grinding.

Tongue biting

Causes

1. When teeth are positioned too far lingually.
2. If the patient had lower posterior teeth missing for a long time, then the intrinsic muscles of the tongue will flatten to fill the space once occupied by the teeth.

Correction

Recontouring the lingual surfaces of the mandibular posterior teeth or remaking the denture.

Difficulty in chewing

- Additional sluiceways and grooves should be added to the occlusal surface.
- The patient should be advised to avoid tough, stringy, or sticky food during the early period of adjustment.

Loose denture

Cause

Retentive clasp tips that were not adjusted accurately or completely into the retentive undercuts.

Patient instruction

Patient's mouth should be examined to observe for the oral hygiene.

Oral hygiene measures should be taught and enforced each time the patient comes for recall.

Maintenance visits should be scheduled every 3, 6, or 12 months.

SPLINTS

Definition

Splint is defined as a prosthesis which maintains a hard and / or soft tissue in a predetermined position.

Splinting is the joining of two or more teeth into a rigid unit by means of fixed or removable restorations.

Types of splinting

- Fixed.
- Removable.
- Overdenture abutments.

Fixed splints

Fixed splinting utilises several single rooted teeth and by the effect of splinting transforms them to a single multi-rooted unit.

Objective

1. Stabilization.
2. Uniform distribution of forces.

Classification

- a. Unilateral (joining of tooth only on the same arch segment).
- b. Bilateral or cross arch (joining of tooth from one arch to the opposite side).

Depending on duration

- a. Provisional/temporary/healing splints.
- b. Permanent splints.

Removable splints

- Done to stabilize weak abutment tooth, which is splinted to the adjacent tooth for strength and stability.
- Continuous clasps with rests and guide planes are prepared to achieve stabilization of the tooth.

Types

Gunning splint

Used to hold the fractured segments in edentulous maxillary and mandibular bones.

Labiolingual splint

Used to reduce fractures in dentulous arches.

Cap splint

Used as a protective splint for bruxers to prevent harmful effects on the tooth and also in fracture reduction.

Fenestrated splints

Used in deciduous teeth when no undercut is present for retention.

Kingsley splint

Used to raise the fractured maxilla.

Cast metal splints

Used for long-term immobilization.

Occlusal splints

Use to raise the plane or protect the anterior tooth.

Overdenture abutments

If widely separated, slightly mobile abutments with 50 percent of bone loss are present; they can be prepared for overdenture abutments.

This will help to retain the overdenture and in turn the overdenture aids in providing a splinting effect on the abutment tooth.

Uses of splints

1. To stabilize periodontally weak tooth.
2. To hold fractured segments together.
3. To hold skin grafts.
4. To protect healthy tissues while administering radiotherapy.
5. To control hemorrhage.
6. To hold periodontal packing, to protect the denuded necks of teeth.
7. To help in drainage of periodontal infections.
8. To aid in healing.
9. To protect the teeth from harmful effects of habits like bruxism.
10. Helps to maintain the continuity of the arch.
11. Helps to immobilize a tooth.
12. Aids in uniform distribution of forces.
13. Helps to support prosthesis.

Other functions of splint

1. Modifies the occlusal contact patterns.
2. Improves masticatory efficiency.
3. Improves form and function of teeth.
4. Improves occlusal plane relations.

Contraindications

1. When bone loss of the concerned tooth is less than 50 percent.
2. When tooth is excessively mobile.
3. When the crown root ratio is less than 1:1.

RADIATION CARRIER**Definition**

A device used to administer radiation to confined areas by means of beads or needles using materials like radium or cesium.

Other names

Radiation applicator, intra-cavity applicator, radiotherapy prosthesis and carrier prosthesis.

Objective

To protect the healthy tissues during radiation therapy and to convey the radiation to the exact location.

Functions

1. Radiation protective shield can be added to radiation carrier to protect the surrounding healthy tissues.
2. Helps to focus the radiation at the required site.
3. The carrier can be used as a device to hold the radioactive material.
4. Helps to select the preloading or after loading technique.

Uses

For lesions in the anterior floor of the mouth, hard and soft palate.

Materials used

- Acrylic resin.
- Silicone.

Parts of a carrier

1. A tube extending out from the area to be radiated.
2. A bulb extending into the area to be radiated.

Fabrication procedure

- An alginate impression is made and cast poured in dental stone.
- The location of the radioactive source is marked and confirmed with the oncologist.
- The dimensions of bulb or portion to extend to the area to be radiated are marked.
- A full coverage prosthesis with a tube and a hollow bulb of the correct dimension is made in acrylic or silicone.
- A metallic shield as Cerrobend alloy of 1 cm thickness can be used in all other areas except the site to be treated.

GUIDING FLANGE

A Guiding flange is a type of treatment prosthesis.

A treatment prosthesis is used for the purpose of treating the tissues that are called on to support and retain it.

Other names

- Mandibular guidance flange.
- Training flange.

Objective

To prevent excessive deviation of the remaining segment in hemi-mandibulectomy patients.

Procedure

- a. An elastic impression material is made and cast poured in dental stone.
- b. An interocclusal record of the intercuspal position is obtained by guiding the patient mouth.
- c. The cast is articulated in occlusion with the remaining segment.

Fabrication procedure

- a. Undercuts are blocked out on the buccal aspect of the tooth of both the upper and lower intact segments.

- b. Stabilising wires are placed across the occlusal surface of tooth from buccal to the lingual aspects in the intact segments.
- c. A partial denture is fabricated with an acrylic plate that extends on the entire aspect of the buccal surface of the lower and upper arch. This acrylic plate extension on the buccal aspect of the tooth prevents the lower segment from deviating.

Modifications

- In case of mild deviations a palatal ramp can be made on the non resected site. The palatal projection prevents the non-resected side from deviating.
- Twin sets of teeth have also been tried to bring back the deviated segment slowly, this helps the patient to have normal functions while the deviation is being corrected.

Recall

The amount of the present deviation is noted and the patient is recalled every two weeks and the amount of deviation corrected is also noted.

The appliance is used until the patient can occlude the non-resected segment without deviation with the opposing intact arch.

TYPES OF REMOVABLE PARTIAL DENTURE

- a. RPI system.
- b. Swing lock RPD.
- c. Fixed removable denture.
- d. Implant supported RPD.
- e. Precision attachment RPD.
- f. Maxillo-facial prosthesis RPD.
- g. Over denture RPD.
- h. Immediate RPD.
- i. Miscellaneous.

RPI system (Rest, Proximal plate, I-bar)

This clasp assembly consists of a mesiocclusal rest with the minor connector placed into the mesiolingual embrasure.

A distal guiding plane, extending from the marginal ridge to the junction of the middle and gingival thirds of the abutment, is prepared to receive a proximal plate. **The proximal plate**, in conjunction with the minor connector supporting the rest, provides the stabilizing and reciprocal aspects of the clasp assembly.

The I-bar should be located in the gingival third of the buccal or labial surface of the abutment in 0.01 inch-undercut.

Swing lock RPD

Shape- It is a half pear shaped bar extending on to the labial surface and occasionally to the facial surface from a lingual plate.

Swing-Lock design, which consists of a labial or buccal bar that is connected to the major connector by a hinge on one end and a latch at the other end.

Support is by multiple rests on the remaining natural teeth. Stabilization and reciprocation by Linguoplate contacting the remaining teeth and by the labial bar with its retentive struts.

Retention is by bar-type retentive clasp arms projecting from the labial or buccal bar.

Labial bar design: The labial bar is designed with small vertical projection arms contacting the labial and buccal surfaces of teeth, gingival to the height of contour.

These vertical arms resemble an I or T bar.

The labial bar can be designed with acrylic retention components especially when resin gingival veneers are required.

Indications

- Extreme lingual inclination of the remaining lower premolar and incisor teeth. Rectification should be attempted by mouth preparation and restoration.
- Large mandibular tori.

Fixed removable partial dentures

Types

- Bar and clip with extended tissue coverage by Dolder, Baker and Hader and Andrews.
- Bar and sleeve designed by Bennett called Bennett Blade.

Parts of fixed removable partial dentures:

- a. Milled substructure bar.
- b. Suprastructure.
- c. Spring wire pins.

Indications

- a. Osseous deformities.
- b. Trauma.
- c. Natural resorption.

Implant supported RPD

The implant is first surgically placed and later the partial denture is fabricated using implant as an abutment.

Rules of implant placement:

- Ridge should be minimum of 5 mm width and 8 mm height.
- Quality of bone and minimum trauma while placing implant is a must.
- To wait for a period of 4 months till it can be loaded (After osseointegration).

Parts:

- Implant with coping screw.
- Bar superstructure.

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Bar superstructure

Bar superstructure has 2 or 3 parts depending on the number of implants to be placed.

- a. Retention bar over the implant.
- b. Bridge bar extending from one implant to the other.
- c. Cantilever implant extending from the distal implant to the free end.

Tissue surface of the denture is fabricated with clips that can fit on to the implant super structure. (Hader clip).

RPD with attachments

Was first developed by Dr. Herman E. S. Chayes in 1906.

Parts of intracoronal retainer: It consists of two units.

- A receptacle that is built into a crown or inlay constructed for an abutment tooth.
- An insert that is attached to the removable partial denture.

Function of each unit

The insert is machined to fit precisely into the receptacle. When a masticatory load is applied to a prosthesis retained by intracoronal retainers, the parallelism of the retainers results in a binding action, resisting dislodging forces.

The action that occurs between the insert and receptacle is a binding, or wedging action.

Another type exists in which the retainer engages vertical walls built into the crown of the abutment tooth to create frictional resistance to removal.

Custom made: Commonest type is a cast dovetail fitting into a counterpart receptacle in the abutment crown.

Prefabricated: They are manufactured attachments and the precision with which they are constructed make the ready-made attachment much preferable to custom made ones.

Examples of few internal attachments are: Ney-Chayes attachment.

Stern-Goldsmith attachment.

Baker attachment.

Advantages

- a. Elimination of a visible retentive component and of a visible vertical rest support.
- b. It provides some horizontal stabilization similar to that of an internal rest.
- c. Better stimulation to the underlying tissues because of intermittent vertical massage.

Maxillofacial prosthesis RPD

Partial dentures with obturators, speech aids and guiding flanges.

These prosthesis aid the patient in speech, mastication and swallowing. In case of surgical obturators they act as a template, preventing infection, also can aid as carriers of medication, hence reducing the pain of patient. Treatment prosthesis such as guiding flange helps to bring back the non-resected side into intercuspal position.

Over denture RPD

A weak tooth or root stump can be retained.

To increase the support of denture, for uniform distribution of forces, to reduce the length of edentulous span and for increasing retention of the prosthesis.

Indications

- a. For additional support to weak tooth.
- b. Supporting RPD with few teeth remaining.
- c. To support an interim prosthesis.

Advantages

1. Decreased ridge resorption.
2. Better retention of the prosthesis.

Immediate RPD

A denture constructed for insertion immediately following extraction of natural teeth.

Other types include

Every dentures: Broad coverage dentures without clasp.

Two part dentures: With different path of insertion, they are locked in place by a bolt.

Spoon dentures: Covers palate without covering gingival margins (3 to 4 mm gingival clearance is given). Commonly used for anterior tooth replacement in children.

Dentures with stress breakers

Stress equalisers can be used in mucosa borne dentures to equalise the forces between the tooth and mucosa.

OBTURATORS

Broad classification is based on

- Stages of treatment.
- The material used.
- Location of restoration.
- Movements.

Based on the stages of treatment:

Surgical obturators

It is defined as, “A temporary prosthesis used to restore the continuity of the hard palate immediately after surgery or traumatic loss of a portion or all of the hard palate and/or contiguous alveolar structures (i. e. gingival tissue, teeth)” - GPT

- Immediate surgical obturator: Inserted at the time of surgery.

- Delayed surgical obturator: Inserted 7–10 days after surgery.

Interim obturators or Tentative Obturators

It is defined as, “A prosthesis that is made several weeks or months following the surgical resection of a portion of one or both maxillae. It frequently includes replacement of teeth in the defect area. This prosthesis, when used, replaces the surgical obturator that is placed immediately following the resection and may be subsequently replaced with a definitive obturator” - GPT.

Definitive Obturators

It is defined as, “A prosthesis that artificially replaces part or all of the maxilla and the associated teeth lost due to surgery or trauma” - GPT.

Based on the material used:

- Metal obturators.
- Resin obturators.
- Silicone obturators.
- Combination of metal and resin.

Based on the location of restoration:

- Palatal obturator.
- Meatal obturator.

Based on the movements:

- Hinge type - Slight vertical movement.
- Fixed type - Utilises soft tissue undercuts.
- Meatus type - Used in extensive clefts, does not extend to Passavant's pad.

Function

1. Aid the patient in speech, mastication and swallowing.

2. Surgical obturators act as a template, preventing infection.
3. Functions as carriers of medication, hence reducing the pain of patient.
4. Prevents from food and water coming through the nose.
5. Helps the patients to attend social functions and get back to their normal self in all ways.

Obturator therapy is required for

1. Congenital defects such as cleft palate.
2. After surgery in patients who had carcinoma.
3. After surgery to retain surgical grafts.
4. Accident cases with palatal defects.
5. Diseases as myasthenia gravis, bulbar poliomyelitis, cerebral palsy. (Palatal lift prosthesis is made).

Palatal Obturator Procedure***Preliminary Impression***

Alginate impression with proper extension recording all undercut areas.

Custom tray oriented into the defect.

Border Moulding

The velo-pharyngeal extension recorded by asking the patient to swallow, flexing the head from side to side, placing the chin down onto the chest and at times asking the patient to pronounce certain syllables.

Final Impression

With elastic impression material.

Jaw Relation

Acrylic denture bases are preferred.

Teeth arrangement

Depending on the existing occlusion.

Insertion and instructions to patient.

Surgical Obturators

- Before surgery an impression is taken and cast is poured in dental stone on which a mock surgery is performed.
- A clear acrylic plate with clasps is made on this cast and inserted after surgery in edentulous patients.
- In case the patient is edentulous, obturator is wired into the alveolar ridge and the zygomatic arch.
- This clear acrylic plate is retained for 7 to 10 days after surgery.
- After 7 to 10 days a delayed surgical obturator is inserted. If this obturator therapy needs to be prolonged then lining of the obturator can be done.
- This obturator is retained for 3 to 4 months post surgically until the wound heals.

Meatal Obturator

This obturator aids in closing the defect between nasal structures and the posterior border of hard palate in extensive soft palate defects. The closure is established against the conchae and the roof of nasal cavity.

Disadvantage

Nasal resonance will be altered.

ARMED CLASPS**One armed clasp**

- Consists of only the retentive arm. This is commonly used along with acrylic removable partial denture.
- This design is used for temporary RPD.

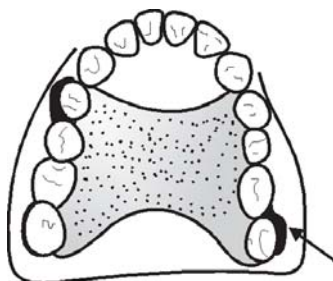


Figure 64: One armed clasp

Two armed clasp

- Consists of a retentive and reciprocal arm. It does not have an occlusal rest.
- Can cause gingival recession, as there is no vertical stop.
- Used in temporary RPD.

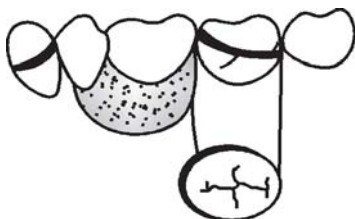


Figure 65: Two armed clasp

Three armed clasp

This is the circumferential clasp.



Figure 66: Three armed clasp

It consists of:

1. Retentive arm,
2. Reciprocal arm.
3. Occlusal rest.

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